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TS-CV-DC

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EDMS Document No
781354

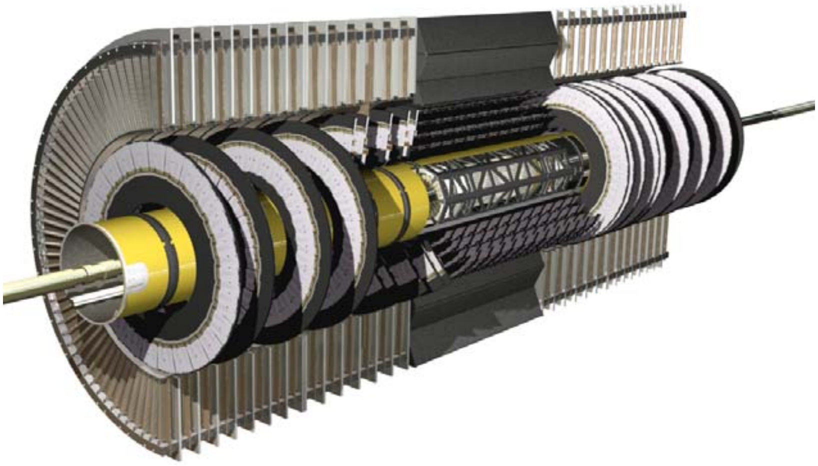
. TS/CV Detector Cooling Project Document No.
186.15.40

TECHNICAL FOLDER – HYDRAULIC PART

TRANSITION RADIATION TRACKER (TRT)

COOLING SYSTEM

FCUM-00004



General description and functionalities

This **TRT cooling plant** cools down the electrical high-voltage cables entering the Atlas experiment sub-detectors, mainly to inner detector. In nominal operating conditions the plant delivers **24 m3/h** of perfluorocarbon C_6F_{14} at **14**°C and 8 **bar** (a). The cooling plant is expected to remove some **70 kW** from the electrical cables.

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History of Changes

Rev. No.	***Date***	***Pages***	***Description of Changes***

HISTORY OF CHANGES

1. INTRODUCTION

Plant Name: MP5 name - **FCUM-00004** (TS/CV/DC project number **186/15/40**)

Location: ATLAS Experimental cavern **UX15**

Design responsible: **Carsten Houd**, TS/CV/DC, tel. 70679

The ATLAS Inner detector (ID) is composed of 3 different particle detectors: The Transition Radiation Tracker (TRT), the Semi-Conductor Tracker (SCT) and Pixel detector. The Inner Detector is placed inside the Liquid Argon Barrel Cryostat.

The cooling system of the Transition Radiation Tracker (TRT) is a monophase cooling system. The TRT cooling system is using a C6F14 perfluorocarbon as a coolant in order to prevent any damage in case of leak inside the detector.

The cooling system consists of the cooling plant (in UX15 level 0 corner of US- and C-side), control rack FCTIR00015 (USA15 CV-room), electro pneumatic rack FCTIR00020 (USA15 CV-room) and liquid analyses and vacuum pumps rack FCTIR00021 (USA15 CV-room).

The cooling plant consists of a 1.5 m3 reservoir large enough to contain all the C6F14 in the installation, a pump, and a heat exchanger connected to the TS/CV chilled water network. The system comprises 4 main circuits going to the distribution racks on HS-structures on the USA- and US-sides supplying the coolant to 200 circuits to the detector. The inlet pressure is constant to all four main lines, and the flow rate is regulated by manual balancing valves.

The station also comprises an emergency heater system of 45 kW designed to protect the installation in case of a vacuum failure on the liquid argon cryostat. Such a failure would expose the liquid to a temperature of 90 °K.

1.1 RELATED DOCUMENTATION

Functional analysis of the TRT cooling system can be found from EDMS 596315 v.1 Functional Analyses for TRT, Cables & Vacuum pumps cooling system.

2. NAMING & SPARE PARTS

2.1 MP5 NAMING

ATLAS TRT Cooling System. Project no. 186.15.40. Monophase cooling system, C6F14.					FCUM-00004
TS-CV responsible: Carsten Houd					
Class	**Category**	**Description**	**Reference fab**	**Comment**	**D7i name**
FVAS	FVAS1	Expansion Tank, 1500 l. STT	Depositos Coballes		FCEE-00015
FVAN	FVANSEC1	Safety valve tank, REV1	CERN Store	100mbar, NPT 1/2"M	FCKE-00046
FECH	FECHPQ1	Plate heat exchanger 70 kW, HPX	SWEP	B35Hx90/1P-SC-S	FCE-00023
FPOM	FPUMPCN1	Circulation pump, VCP	ITT Richter	ICM 80-50-250.	FCP-00052
FPOM	FPUMPHE1	Vacuum pump, VP	KNF Neuberger	KNF type NPK 100	FCP-00053
FINS	FINSNIV1	Ultra-sonic Level Transmitter, WLT	Solartron Mobrey	MSP400RH-B28.	FCLT-00011
FINS	FINSPRE1	Pressure switch, PZA1	Huba Control	Press.-50/-600	FCPS-00032
FINS	FINSPRE1	Pressure transmitter, PT1	Huba Control	Pressure transmitter	FCPT-00107
FINS	FINSPRE1	Pressure transmitter, PT2	Huba Control	Pressure transmitter	FCPT-00108
FINS	FINSTEM1	Pt100 Heaters, TT1	Thermo-Est	Type SI 1119 F/L/3F/A	FCTT-00130
FINS	FINSTEM1	Pt100 Station Out, TT10	Thermo-Est	Sonde Pt100; Type SI	FCTT-00131
FINS	FINSTEM1	Pt100 Station In, TT11	Thermo-Est	Sonde Pt100; Type SI	FCTT-00132
FINS	FINSTEM1	Pt100 mixed water supply, TT12	Thermo-Est	Sonde Pt100; Type SI	FCTT-00133
FINS	FINSTEM1	Pt100 mixed water return, TT13	Thermo-Est	Sonde Pt100; Type SI	FCTT-00134
FINS	FINSPRE1	Manometer Station out, PG1	CERN Store	-1+10b D100	FCPG-00022
FINS	FINSPRE1	Manometer Station in, PG2	CERN Store	Manometer blondelle	FCPG-00023
FINS	FFILECA1	Dehydrating filter 1, CF1	M. Paulus	Filter cartridge: WC48X	FCF-00036
FILT	FFILECA1	Dehydrating filter 2, CF2	M. Paulus	Filter cartridge: WC48X	FCF-00037
FILT	FFILECA1	Strainer chilled water circuit, STR1	Tecofi	Filtre a tamis DN40	FCF-00038
FVAN	FVANRED1	Diff. pressure regulator, DPR	SART von Rohr	SART type 5362L4,	FCPV-00012
FVAN	FVANMOT1	Electro-valve for vac. Pump	CERN Store		FCV-00364
FVAN	FVANMOT1	Control valve mixed water, PCVA1	Sauter SA	V6F40 F304, Kvs	FCV-00365
FINS	FINSDEB1	Flowmeter, mixed water, FZA1	Actaris	Woltman DN50	FCFIC-00041
FBAT	FBATEL1	Heater 12kW, HEA1	Cetal	ref. 77C16-120 +	FCI-00060
FBAT	FBATEL1	Heater 12kW, HEA2	Cetal	ref. 77C16-120 +	FCI-00061
FBAT	FBATEL1	Heater 12kW, HEA3	Cetal	ref. 77C16-120 +	FCI-00062
FBAT	FBATEL1	Heater 9kW, HEA4	Cetal	ref. 77C16-090 +	FCI-00063
FVAN	FVANMOT1	Pneum. Ball valve PVA1	Meca-Inox	Ball valve 316, 1"1/4 w.	FCV-00366
FVAN	FVANMOT1	Pneum. Ball valve PVA2	Meca-Inox	Ball valve 316, 1"1/4 w.	FCV-00367
FVAN	FVANMOT1	Pneum. Ball valve PVA3	Meca-Inox	Ball valve 316, 1"1/4 w.	FCV-00368
FVAN	FVANMOT1	Pneum. Ball valve PVA4	Meca-Inox	Ball valve 316, 1"1/4 w.	FCV-00369
FVAN	FVANMOT1	Pneum. Ball valve PVA5	Meca-Inox	Ball valve 316, 1"1/2 w.	FCV-00370
FVAN	FVANMOT1	Pneum. Ball valve PVA6	Meca-Inox	Ball valve 316, 1"1/2 w.	FCV-00371
FVAN	FVANMOT1	Pneum. Ball valve PVA7	Meca-Inox	Ball valve 316, 1"1/2 w.	FCV-00372
FVAN	FVANMOT1	Pneum. Ball valve PVA8	Meca-Inox	Ball valve 316, 1"1/2 w.	FCV-00373
FVAN	FVANMOT1	Pneum. Ball valve PVA9	Meca-Inox	Ball valve 316, 1/2" w.	FCV-00374
FVAN	FVANMOT1	Pneum. Ball valve PVA10	Meca-Inox	Ball valve 316, 1/2" w.	FCV-00375
FVAN	FVANMOT1	Balancing valve BAV1	TA Hydronics	STADA Kvs 14.2 Art.	FCV-00376
FVAN	FVANMOT1	Balancing valve BAV2	TA Hydronics	STADA Kvs 14.2 Art.	FCV-00377
FVAN	FVANMOT1	Balancing valve BAV3	TA Hydronics	STADA Kvs 14.2 Art.	FCV-00378
FVAN	FVANMOT1	Balancing valve BAV4	TA Hydronics	STADA Kvs 14.2 Art.	FCV-00379
FINS	FINSDEB1	Flow sight glass, FSG1	Meca-Inox	VC4LTGNI 40	FCFG-00080
FINS	FINSDEB1	Flow sight glass, FSG2	Meca-Inox	VC4LTGNI 40	FCFG-00081
FINS	FINSDEB1	Flow sight glass, FSG3	Meca-Inox	VC4LTGNI 40	FCFG-00082
FINS	FINSDEB1	Flow sight glass, FSG4	Meca-Inox	VC4LTGNI 40	FCFG-00083
FINS	FINSDEB1	Flow sight glass, FSG10	Meca-Inox	VC4LTGNI 15	FCFG-00084
FINS	FINSPRE1	Manometer Rack 1, PG3	Manometer AG	232..50.063: 0.....6 bar	FCPG-00024
FINS	FINSPRE1	Manometer Rack 5, PG4	Manometer AG	232..50.063: -1.....+1.5	FCPG-00025
FINS	FINSPRE1	Manometer Rack 2, PG5	Manometer AG	232..50.063: 0.....6 bar	FCPG-00026
FINS	FINSPRE1	Manometer Rack 6, PG6	Manometer AG	232..50.063: -1.....+1.5	FCPG-00027
FINS	FINSPRE1	Manometer Rack 3, PG7	Manometer AG	232..50.063: 0.....6 bar	FCPG-00028
FINS	FINSPRE1	Manometer Rack 7, PG8	Manometer AG	232..50.063: -1.....+1.5	FCPG-00029

FINS	FINSPRE1	Manometer Rack 4, PG9	Manometer AG	232..50.063: 0.....6 bar	FCPG-00030
FINS	FINSPRE1	Manometer Rack 8, PG10	Manometer AG	232..50.063: -1.....+1.5	FCPG-00031
FVAN	FVANSEC1	Safety valve Rack 1, Rev3	Swagelok	SS RL3S8MM, inox	FCKE-00047
FVAN	FVANSEC1	Safety valve Rack 5, Rev4	Swagelok	SS RL3S8MM, inox	FCKE-00048
FVAN	FVANSEC1	Safety valve Rack 2, Rev5	Swagelok	SS RL3S8MM, inox	FCKE-00049
FVAN	FVANSEC1	Safety valve Rack 6, Rev6	Swagelok	SS RL3S8MM, inox	FCKE-00050
FVAN	FVANSEC1	Safety valve Rack 3, Rev7	Swagelok	SS RL3S8MM, inox	FCKE-00051
FVAN	FVANSEC1	Safety valve Rack 7, Rev8	Swagelok	SS RL3S8MM, inox	FCKE-00052
FVAN	FVANSEC1	Safety valve Rack 4, Rev9	Swagelok	SS RL3S8MM, inox	FCKE-00053
FVAN	FVANSEC1	Safety valve Rack 8, Rev10	Swagelok	SS RL3S8MM, inox	FCKE-00054
FVAN	FVANMAN1	Pressure reducing valve Rack 1, PR3	Zurcher Technik	Type 10 TER DN32	FCV-00380
FVAN	FVANMAN1	Pressure reducing valve Rack 2, PR4	Zurcher Technik	Type 10 TER DN32	FCV-00381
FVAN	FVANMAN1	Pressure reducing valve Rack 3, PR5	Zurcher Technik	Type 10 TER DN32	FCV-00382
FVAN	FVANMAN1	Pressure reducing valve Rack 4, PR6	Zurcher Technik	Type 10 TER DN32	FCV-00383
FVAN	FVANMAN1	Balancing valve Rack 1 line 1A1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00384
FVAN	FVANMAN1	Balancing valve Rack 1 line 1A2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00385
FVAN	FVANMAN1	Balancing valve Rack 1 line 1A3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00386
FVAN	FVANMAN1	Balancing valve Rack 1 line 1A4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00387
FVAN	FVANMAN1	Balancing valve Rack 1 line 1A5	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00388
FVAN	FVANMAN1	Balancing valve Rack 1 line 1A6	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00389
FVAN	FVANMAN1	Balancing valve Rack 1 line 1B1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00390
FVAN	FVANMAN1	Balancing valve Rack 1 line 1B2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00391
FVAN	FVANMAN1	Balancing valve Rack 1 line 1B3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00392
FVAN	FVANMAN1	Balancing valve Rack 1 line 1B4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00393
FVAN	FVANMAN1	Balancing valve Rack 1 line 1B5	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00394
FVAN	FVANMAN1	Balancing valve Rack 1 line 1B6	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00395
FVAN	FVANMAN1	Balancing valve Rack 1 line 1C1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00396
FVAN	FVANMAN1	Balancing valve Rack 1 line 1C2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00397
FVAN	FVANMAN1	Balancing valve Rack 1 line 1C3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00398
FVAN	FVANMAN1	Balancing valve Rack 1 line 1C4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00399
FVAN	FVANMAN1	Balancing valve Rack 1 line 1C5	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00400
FVAN	FVANMAN1	Balancing valve Rack 1 line 1C6	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00401
FVAN	FVANMAN1	Balancing valve Rack 1 line 1D1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00402
FVAN	FVANMAN1	Balancing valve Rack 1 line 1D2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00403
FVAN	FVANMAN1	Balancing valve Rack 1 line 1D3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00404
FVAN	FVANMAN1	Balancing valve Rack 1 line 1D4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00405
FVAN	FVANMAN1	Balancing valve Rack 1 line 1D5	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00406
FVAN	FVANMAN1	Balancing valve Rack 1 line 1D6	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00407
FVAN	FVANMAN1	Balancing valve Rack 1 line 1E1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00408
FVAN	FVANMAN1	Balancing valve Rack 1 line 1E2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00409
FVAN	FVANMAN1	Balancing valve Rack 1 line 1E3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00410
FVAN	FVANMAN1	Balancing valve Rack 1 line 1E4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00411
FVAN	FVANMAN1	Balancing valve Rack 1 line 1F1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00412
FVAN	FVANMAN1	Balancing valve Rack 1 line 1F2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00413
FVAN	FVANMAN1	Balancing valve Rack 1 line 1F3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00414
FVAN	FVANMAN1	Balancing valve Rack 1 line 1F4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00415
FVAN	FVANMAN1	Balancing valve Rack 1 line 1G1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00416
FVAN	FVANMAN1	Balancing valve Rack 1 line 1G2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00417
FVAN	FVANMAN1	Balancing valve Rack 1 line 1G3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00418
FVAN	FVANMAN1	Balancing valve Rack 1 line 1G4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00419
FVAN	FVANMAN1	Balancing valve Rack 1 line 1H1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00420
FVAN	FVANMAN1	Balancing valve Rack 1 line 1H2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00421
FVAN	FVANMAN1	Balancing valve Rack 1 line 1H3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00422
FVAN	FVANMAN1	Balancing valve Rack 1 line 1H4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00423
FVAN	FVANMAN1	Balancing valve Rack 1 line 1I1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00424
FVAN	FVANMAN1	Balancing valve Rack 1 line 1I2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00425
FVAN	FVANMAN1	Balancing valve Rack 1 line 1I3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00426
FVAN	FVANMAN1	Balancing valve Rack 1 line 1I4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00427
FVAN	FVANMAN1	Balancing valve Rack 1 line 1J1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00428
FVAN	FVANMAN1	Balancing valve Rack 1 line 1J2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00429
FVAN	FVANMAN1	Balancing valve Rack 1 line 1J3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00430
FVAN	FVANMAN1	Balancing valve Rack 1 line 1K1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00431
FVAN	FVANMAN1	Balancing valve Rack 1 line 1K2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00432
FVAN	FVANMAN1	Balancing valve Rack 1 line 1K3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00433
FVAN	FVANMAN1	Balancing valve Rack 2 line 2A1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00434

FVAN	FVANMAN1	Balancing valve Rack 2 line 2A2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00435
FVAN	FVANMAN1	Balancing valve Rack 2 line 2A3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00436
FVAN	FVANMAN1	Balancing valve Rack 2 line 2A4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00437
FVAN	FVANMAN1	Balancing valve Rack 2 line 2A5	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00438
FVAN	FVANMAN1	Balancing valve Rack 2 line 2A6	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00439
FVAN	FVANMAN1	Balancing valve Rack 2 line 2B1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00440
FVAN	FVANMAN1	Balancing valve Rack 2 line 2B2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00441
FVAN	FVANMAN1	Balancing valve Rack 2 line 2B3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00442
FVAN	FVANMAN1	Balancing valve Rack 2 line 2B4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00443
FVAN	FVANMAN1	Balancing valve Rack 2 line 2B5	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00444
FVAN	FVANMAN1	Balancing valve Rack 2 line 2B6	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00445
FVAN	FVANMAN1	Balancing valve Rack 2 line 2C1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00446
FVAN	FVANMAN1	Balancing valve Rack 2 line 2C2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00447
FVAN	FVANMAN1	Balancing valve Rack 2 line 2C3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00448
FVAN	FVANMAN1	Balancing valve Rack 2 line 2C4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00449
FVAN	FVANMAN1	Balancing valve Rack 2 line 2C5	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00450
FVAN	FVANMAN1	Balancing valve Rack 2 line 2C6	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00451
FVAN	FVANMAN1	Balancing valve Rack 2 line 2D1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00452
FVAN	FVANMAN1	Balancing valve Rack 2 line 2D2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00453
FVAN	FVANMAN1	Balancing valve Rack 2 line 2D3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00454
FVAN	FVANMAN1	Balancing valve Rack 2 line 2D4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00455
FVAN	FVANMAN1	Balancing valve Rack 2 line 2D5	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00456
FVAN	FVANMAN1	Balancing valve Rack 2 line 2D6	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00457
FVAN	FVANMAN1	Balancing valve Rack 2 line 2E1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00458
FVAN	FVANMAN1	Balancing valve Rack 2 line 2E2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00459
FVAN	FVANMAN1	Balancing valve Rack 2 line 2E3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00460
FVAN	FVANMAN1	Balancing valve Rack 2 line 2E4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00461
FVAN	FVANMAN1	Balancing valve Rack 2 line 2F1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00462
FVAN	FVANMAN1	Balancing valve Rack 2 line 2F2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00463
FVAN	FVANMAN1	Balancing valve Rack 2 line 2F3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00464
FVAN	FVANMAN1	Balancing valve Rack 2 line 2F4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00465
FVAN	FVANMAN1	Balancing valve Rack 2 line 2G1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00466
FVAN	FVANMAN1	Balancing valve Rack 2 line 2G2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00467
FVAN	FVANMAN1	Balancing valve Rack 2 line 2G3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00468
FVAN	FVANMAN1	Balancing valve Rack 2 line 2G4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00469
FVAN	FVANMAN1	Balancing valve Rack 2 line 2H1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00470
FVAN	FVANMAN1	Balancing valve Rack 2 line 2H2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00471
FVAN	FVANMAN1	Balancing valve Rack 2 line 2H3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00472
FVAN	FVANMAN1	Balancing valve Rack 2 line 2H4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00473
FVAN	FVANMAN1	Balancing valve Rack 2 line 2I1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00474
FVAN	FVANMAN1	Balancing valve Rack 2 line 2I2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00475
FVAN	FVANMAN1	Balancing valve Rack 2 line 2I3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00476
FVAN	FVANMAN1	Balancing valve Rack 2 line 2I4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00477
FVAN	FVANMAN1	Balancing valve Rack 2 line 2J1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00478
FVAN	FVANMAN1	Balancing valve Rack 2 line 2J2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00479
FVAN	FVANMAN1	Balancing valve Rack 2 line 2J3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00480
FVAN	FVANMAN1	Balancing valve Rack 2 line 2K1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00481
FVAN	FVANMAN1	Balancing valve Rack 2 line 2K2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00482
FVAN	FVANMAN1	Balancing valve Rack 2 line 2K3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00483
FVAN	FVANMAN1	Balancing valve Rack 3 line 3A1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00484
FVAN	FVANMAN1	Balancing valve Rack 3 line 3A2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00485
FVAN	FVANMAN1	Balancing valve Rack 3 line 3A3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00486
FVAN	FVANMAN1	Balancing valve Rack 3 line 3A4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00487
FVAN	FVANMAN1	Balancing valve Rack 3 line 3A5	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00488
FVAN	FVANMAN1	Balancing valve Rack 3 line 3A6	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00489
FVAN	FVANMAN1	Balancing valve Rack 3 line 3B1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00490
FVAN	FVANMAN1	Balancing valve Rack 3 line 3B2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00491
FVAN	FVANMAN1	Balancing valve Rack 3 line 3B3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00492
FVAN	FVANMAN1	Balancing valve Rack 3 line 3B4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00493
FVAN	FVANMAN1	Balancing valve Rack 3 line 3B5	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00494
FVAN	FVANMAN1	Balancing valve Rack 3 line 3B6	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00495
FVAN	FVANMAN1	Balancing valve Rack 3 line 3C1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00496
FVAN	FVANMAN1	Balancing valve Rack 3 line 3C2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00497
FVAN	FVANMAN1	Balancing valve Rack 3 line 3C3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00498

FVAN	FVANMAN1	Balancing valve Rack 3 line 3C4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00499
FVAN	FVANMAN1	Balancing valve Rack 3 line 3C5	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00500
FVAN	FVANMAN1	Balancing valve Rack 3 line 3C6	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00501
FVAN	FVANMAN1	Balancing valve Rack 3 line 3D1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00502
FVAN	FVANMAN1	Balancing valve Rack 3 line 3D2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00503
FVAN	FVANMAN1	Balancing valve Rack 3 line 3D3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00504
FVAN	FVANMAN1	Balancing valve Rack 3 line 3D4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00505
FVAN	FVANMAN1	Balancing valve Rack 3 line 3D5	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00506
FVAN	FVANMAN1	Balancing valve Rack 3 line 3D6	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00507
FVAN	FVANMAN1	Balancing valve Rack 3 line 3E1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00508
FVAN	FVANMAN1	Balancing valve Rack 3 line 3E2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00509
FVAN	FVANMAN1	Balancing valve Rack 3 line 3E3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00510
FVAN	FVANMAN1	Balancing valve Rack 3 line 3E4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00511
FVAN	FVANMAN1	Balancing valve Rack 3 line 3F1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00512
FVAN	FVANMAN1	Balancing valve Rack 3 line 3F2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00513
FVAN	FVANMAN1	Balancing valve Rack 3 line 3F3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00514
FVAN	FVANMAN1	Balancing valve Rack 3 line 3F4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00515
FVAN	FVANMAN1	Balancing valve Rack 3 line 3G1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00516
FVAN	FVANMAN1	Balancing valve Rack 3 line 3G2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00517
FVAN	FVANMAN1	Balancing valve Rack 3 line 3G3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00518
FVAN	FVANMAN1	Balancing valve Rack 3 line 3G4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00519
FVAN	FVANMAN1	Balancing valve Rack 3 line 3H1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00520
FVAN	FVANMAN1	Balancing valve Rack 3 line 3H2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00521
FVAN	FVANMAN1	Balancing valve Rack 3 line 3H3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00522
FVAN	FVANMAN1	Balancing valve Rack 3 line 3H4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00523
FVAN	FVANMAN1	Balancing valve Rack 3 line 3I1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00524
FVAN	FVANMAN1	Balancing valve Rack 3 line 3I2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00525
FVAN	FVANMAN1	Balancing valve Rack 3 line 3I3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00526
FVAN	FVANMAN1	Balancing valve Rack 3 line 3I4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00527
FVAN	FVANMAN1	Balancing valve Rack 3 line 3J1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00528
FVAN	FVANMAN1	Balancing valve Rack 3 line 3J2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00529
FVAN	FVANMAN1	Balancing valve Rack 3 line 3J3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00530
FVAN	FVANMAN1	Balancing valve Rack 3 line 3K1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00531
FVAN	FVANMAN1	Balancing valve Rack 3 line 3K2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00532
FVAN	FVANMAN1	Balancing valve Rack 3 line 3K3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00533
FVAN	FVANMAN1	Balancing valve Rack 4 line 4A1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00534
FVAN	FVANMAN1	Balancing valve Rack 4 line 4A2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00535
FVAN	FVANMAN1	Balancing valve Rack 4 line 4A3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00536
FVAN	FVANMAN1	Balancing valve Rack 4 line 4A4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00537
FVAN	FVANMAN1	Balancing valve Rack 4 line 4A5	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00538
FVAN	FVANMAN1	Balancing valve Rack 4 line 4A6	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00539
FVAN	FVANMAN1	Balancing valve Rack 4 line 4B1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00540
FVAN	FVANMAN1	Balancing valve Rack 4 line 4B2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00541
FVAN	FVANMAN1	Balancing valve Rack 4 line 4B3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00542
FVAN	FVANMAN1	Balancing valve Rack 4 line 4B4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00543
FVAN	FVANMAN1	Balancing valve Rack 4 line 4B5	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00544
FVAN	FVANMAN1	Balancing valve Rack 4 line 4B6	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00545
FVAN	FVANMAN1	Balancing valve Rack 4 line 4C1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00546
FVAN	FVANMAN1	Balancing valve Rack 4 line 4C2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00547
FVAN	FVANMAN1	Balancing valve Rack 4 line 4C3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00548
FVAN	FVANMAN1	Balancing valve Rack 4 line 4C4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00549
FVAN	FVANMAN1	Balancing valve Rack 4 line 4C5	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00550
FVAN	FVANMAN1	Balancing valve Rack 4 line 4C6	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00551
FVAN	FVANMAN1	Balancing valve Rack 4 line 4D1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00552
FVAN	FVANMAN1	Balancing valve Rack 4 line 4D2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00553
FVAN	FVANMAN1	Balancing valve Rack 4 line 4D3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00554

FVAN	FVANMAN1	Balancing valve Rack 4 line 4D4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00555
FVAN	FVANMAN1	Balancing valve Rack 4 line 4D5	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00556
FVAN	FVANMAN1	Balancing valve Rack 4 line 4D6	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00557
FVAN	FVANMAN1	Balancing valve Rack 4 line 4E1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00558
FVAN	FVANMAN1	Balancing valve Rack 4 line 4E2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00559
FVAN	FVANMAN1	Balancing valve Rack 4 line 4E3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00560
FVAN	FVANMAN1	Balancing valve Rack 4 line 4E4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00561
FVAN	FVANMAN1	Balancing valve Rack 4 line 4F1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00562
FVAN	FVANMAN1	Balancing valve Rack 4 line 4F2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00563
FVAN	FVANMAN1	Balancing valve Rack 4 line 4F3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00564
FVAN	FVANMAN1	Balancing valve Rack 4 line 4F4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00565
FVAN	FVANMAN1	Balancing valve Rack 4 line 4G1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00566
FVAN	FVANMAN1	Balancing valve Rack 4 line 4G2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00567
FVAN	FVANMAN1	Balancing valve Rack 4 line 4G3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00568
FVAN	FVANMAN1	Balancing valve Rack 4 line 4G4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00569
FVAN	FVANMAN1	Balancing valve Rack 4 line 4H1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00570
FVAN	FVANMAN1	Balancing valve Rack 4 line 4H2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00571
FVAN	FVANMAN1	Balancing valve Rack 4 line 4H3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00572
FVAN	FVANMAN1	Balancing valve Rack 4 line 4H4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00573
FVAN	FVANMAN1	Balancing valve Rack 4 line 4I1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00574
FVAN	FVANMAN1	Balancing valve Rack 4 line 4I2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00575
FVAN	FVANMAN1	Balancing valve Rack 4 line 4I3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00576
FVAN	FVANMAN1	Balancing valve Rack 4 line 4I4	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00577
FVAN	FVANMAN1	Balancing valve Rack 4 line 4J1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00578
FVAN	FVANMAN1	Balancing valve Rack 4 line 4J2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00579
FVAN	FVANMAN1	Balancing valve Rack 4 line 4J3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00580
FVAN	FVANMAN1	Balancing valve Rack 4 line 4K1	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00581
FVAN	FVANMAN1	Balancing valve Rack 4 line 4K2	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00582
FVAN	FVANMAN1	Balancing valve Rack 4 line 4K3	TA Hydronics	STAD Kvs 1.47 Art.	FCV-00583

2.2 GENERAL NAMING

Components		Lines	
ACH	Air cooled water chiller	**AL**	Analog signal line
BAV	Balancing valve	**CWL**	Chilled water line
BOV	Booster	**DL**	Digital line
BPR	Back pressure regulator	**DGL**	Distribution gas/vapor line
BTV	Butterfly valve	**DLL**	Distribution liquid line
BUF	Buffer tank	**DWL**	Demineralized water line
CBV	Compact ball valve	**GL**	Gas line
CEP	Converter E->P	**IGL**	Intermediate gas/vapor line
CF	Chemical filter	**ILL**	Intermediate liquid line
CHV	Check valve	**LL**	Liquid line
CIR	Circulator	**MGL**	Main gas/vapor line
COP	Piston compresor	**MLL**	Main liquid line
CSC	Control scale	**MWL**	Mixed water line
DPR	Differential pressure regulator	**PL**	Pneumatic line
ECVA	Electrical control valve 2 ways	**PWL**	Power line
ECVB	Electrical control valve 3 ways	**VL**	Vacuum line
EI	Switch control (manual valve)		
EVA	Electrovalve 2 ways		
EVB	Electrovalve 3 ways		
FRA	Frame		
FSG	Flow sight glass		
FZA	Flow controller		
GFL	Gas flowmeter		
HCP	Horizontal centrifugal pump		
HEA	Resistance heater		
HPX	Heat plate exchanger		
LFL	Liquid flowmeter		
MCVA	Manual control valve 2 ways		
MCVB	Manual control valve 3 ways		
MDP	Magnetic drive centrifugal pump		
MF	Mechanical filter		
MVA	Manual valve 2 ways		
MVB	Manual valve 2 ways		
PCVA	Pneumatic control valve 2 ways		
PCVB	Pneumatic control valve 3 ways		
PG	Pressure gauge		
PR	Pressure regulator		
PT	Pressure transmitter		
PVA	Pneumatic valve 2 ways		
PVB	Pneumatic valve 3 ways		
PZA	Pressure switch		
QT	Conductivity transmitter		
REV	Relief valve		
RFB	Resin filter body		
RFC	Resin filter cartridge		
STR	Strainer		
STT	Storage tank		
TA	Temperature controller / alarm		
TT	Temperature transmitter		
TVA	Thermostatic valve 2 ways		
TVB	Thermostatic valve 3 ways		
VCP	Vertical centrifugal pump		
VP	Vacuum pump		
WLT	Water level transmitter		

2.3 NAMING OF THE PIPING

2.4 SPARE PART LIST

Part No.	Description	UOM	Manufacturer	Preferred Supplier	Supplier reference
	Legris copper gasket M36	pc	Legris	Angst + Pfister	10.6408.3600
	Legris copper gasket M42	pc	Legris	Angst + Pfister	10.6408.4200
F05-07-005	High capacity cartridge, type DCR 48-DM	pc	Danfoss	Werner Kuster SA	Art.N° 023U1391
F05-07-006	High capacity cartridge, type DCR 48-F	pc	Danfoss	Werner Kuster SA	Art.N°. 023U1921
F05-08-009	Solartron Mobrey ultra-sonic level transmitter	pc	Solartron Mobrey	Solartron Mobrey	MSP400RH-B28.
F05-08-010	Huba Control pressure transmitter, 0-2.5 b(a)	pc	Huba Control	Huba Control	Type 680 for CERN, 0-2.5 bar.a
F05-08-011	Huba Control pressure transmitter, 0-10 b(a)	pc	Huba Control	Huba Control	Type 680 for CERN, 0-10 bar.a
F05-08-006	Thermo-Est Pt100 temperature transmitter	pc	Thermo-Est	Thermo-Est	Sonde Pt100; Type SI 1119 F/L/3F/A
	CETAL Thermo plongeur, 12 kW. 4 W/cm2	pc	CETAL		ref. 77 C 16 120
	CETAL Thermo plongeur, 9 kW. 4 W/cm2	pc	CETAL		ref. 77 C 16 090
	Presse-etoupe pour Sauter V6F40 F304 - DN40				
F05-10-003	KNF type NPK 100 vacuum pump	pc	KNF	KNF Neuberger	NPK 100
F05-03-009	Viton rubber diaphragm for SART 5362 L4	pc	SART Von Rohr	Ribat	
F25-06-006	El. valve 3/2.1/4G.NO.131K04	pc		CERN Store	18.60.80.905.3
F05-03-011	Pneumatic actuator Elomatic for valve DN10/15	pc	Elomatic	Ribat	ES25
	Pneumatic actuator Air Torque for valve DN32/40	pc	Air Torque	Zurcher Technik	AT 250 S012 A
	Gasket UHMWE PE for ball valve DN32	pc	Zurcher Technik	Zurcher Technik	A2416D-400R
	Gasket UHMWE PE for ball valve DN40	pc	Zurcher Technik	Zurcher Technik	A2417D-400R
	Gasket UHMWE for Meca-Inox valve DN50	pc	Meca-Inox	Zurcher Technik	PH4LBWNI 50
	Gasket UHMWE for Meca-Inox valve DN65	pc	Meca-Inox	Zurcher Technik	PH4LBWNI 65
F05-03-019	Replacement glass for Meca-Inox sight glass DN15 FB / DN20 RB	pc	Meca-Inox	Ribat	Verre de rechange viseur Meca-Inox DN15 PI / DN20 PR
F05-03-016	Replacement glass for Meca-Inox sight glass DN40	pc	Meca-Inox	Ribat	Verre de rechange viseur Meca-Inox DN40
F05-08-012	Woltex M flowmeter, DN50 Q=25-50 m3/h	pc	Woltman	Actaris SA	N° art.120205
F05-08-015	Actaris Cyble sensor	pc	Actaris SA	Actaris SA	N° art. 120433
	Gasket Nitril for back pressure regulator Type 10 TER DN32	pc	Zurcher Technik		Type 10 TER DN32
	Soupape inox a ouverture proportionelle, serie RL3 basse pression	pc	Swagelok		No. art: SS RL3S8MM
	Joint spirale LG13 pour bride DIN, DN32	pc	Angst + Pfister		No. d'art.: 10.3205.0610
	Joint spirale LG13 pour bride DIN, DN40	pc	Angst + Pfister		No. d'art.: 10.3205.0612
	Vanne d'equilibrage TA Hydronics DN10 female	pc	TA Hydronics		Code 151-009
	Vanne d'equilibrage TA Hydronics DN32 male	pc	TA Hydronics		Code 152-032
	Stainless steel manometer, Scale 0...6 bar. D=63mm	pc	WIKA	Manometer AG	No. art: 9204436
	Stainless steel manometer, Scale -1...+1.5 bar. D=63mm	pc	WIKA	Manometer AG	No. art: 9640339
	ITT Richter pompe magnetique ICM 80-50-250		ITT Richter	Chemie-Technik AG	
	IEC moteur type 160 L, B3, 18.5 kW				
	Corps pompe, Pos. 100		ITT Richter	Chemie-Technik AG	Art. No. 9338-15-1812
	Joint de corps, Pos. 401		ITT Richter	Chemie-Technik AG	Art. No. 9338-53-1010
	Support de palier interne, Pos. 339		ITT Richter	Chemie-Technik AG	Art. No. 9338-31-4201
	Roue ferme, Pos. 230		ITT Richter	Chemie-Technik AG	Art. No. 9338-33-1852
	Inducer, Pos. 236		ITT Richter	Chemie-Technik AG	Art. No. 9338-33-1845
	Support de palier cartouche, Pos. 310		ITT Richter	Chemie-Technik AG	Art. No. 9337-39-1050
	Rondelle d'ecartement, Pos. 551		ITT Richter	Chemie-Technik AG	Art. No. 9338-65-1001

	Bague intermediaire, Pos. 509		ITT Richter	Chemie-Technik AG	Art. No. 9338-53-1121
	Rotor interne, Pos. 859		ITT Richter	Chemie-Technik AG	Art. No. 9337-93-3068
	Axe pour rotor interne, Pos. 220		ITT Richter	Chemie-Technik AG	Art. No. 9338-64-1071
	Pot arriere, Pos. 159		ITT Richter	Chemie-Technik AG	Art. No. 9338-35-1001
	Joint de pot arriere, Pos. 406		ITT Richter	Chemie-Technik AG	Art. No. 9338-53-1140
	Rotor d'entrainement, Pos. 858		ITT Richter	Chemie-Technik AG	Art. No. 9337-41-1403
	Laterne, Pos. 344		ITT Richter	Chemie-Technik AG	Art. No. 9338-24-1006
	Joint plat, Pos. 400		ITT Richter	Chemie-Technik AG	Art. No. 9338-53-1101
	ITT Richter pompe magnetique ICM 80-50-200		ITT Richter	Chemie-Technik AG	
	IEC moteur type 160 L, B35, 18.5 kW				

3. HYDRAULIC DOSSIER

The specification of the Liquid argon cooling system can be found in EDMS 391190 – ATC-TL-EP 0002 v.2 COOLING PLANT FOR TRT. The drawings, purchase orders and component manuals can be found in Annexes.

3.1 LCS V.2 OPERATING PRINCIPLE

The liquid is held in a storage tank (3) maintained below atmospheric pressure by a vacuum pump (2). A check valve discharges any excess air in the event of drainage and prevents the pressure in the storage tank from rising above atmospheric pressure. The liquid is moved into the exchangers (1) incorporated through the electronic system by a circulator (4).
The pressure at the various points of the circuit depends on the head losses and hydrostatic pressures.

At start-up, if the pressure in the storage tank is not low enough the vacuum pump is activated. While the later is in operation, in the event of an air intake for instance, the circulator cannot run. The pressure throughout the circuit still equal to the pressure in the storage tank.

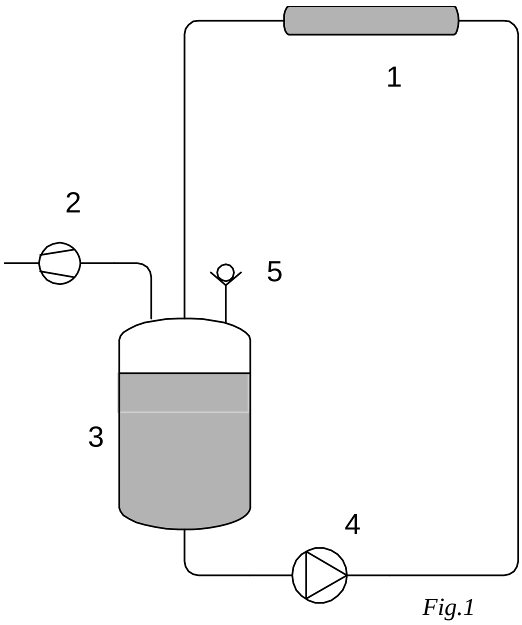


Fig.1

3.2 COOLING STATION

This cooling system is designed to evacuate 70 kW from the electronics of the TRT detector. The unit is a closed liquid circuit working according to the LCS v.2 principle and connected to a primary circuit through an heat exchanger. A Programmable Logical Controller controls the operation. Due to space constraint the manifold unit is separated from the cooling station itself

The distribution racks distributes the cooling liquid to 200 channels inside the TRT detector.

- The primary circuit is the ATLAS chilled water circuit
  - Inlet 5°C
  - Return 11°C
  - Flow rate 10 m3/h
- The secondary circuit : Perfluorocarbon C6F14 (density 1.688 @20°C)
  - Inlet 14°C
  - Return 20°C
  - Flow rate 24 [m3/h]
  - Number of channels: 200

A circulator pump moves the fluid from a pressurized storage tank to the exchangers through a brazed plates heat exchanger connected to the primary circuit via a pneumatic 2 ways valve. The temperature is controled by a PID module inside the PLC. The circuit supply pressure is regulated by a back pressure regulation valve on a by-pass.

- Pump specifications:
    - Horizontal magnetic drive centrifugal pump
    - Flow max : 24 [m3/h] at head max 60[m].
    - Power: 22 kW (comes directly from UX15)

(Maximum Head requirement: 1024 mbar in lines, 500 mbar in the station, 500 mbar in the heat exchanger, 3300 mbar in height difference, 800 mbar inside detector + 20%)

- Back pressure regulator specifications:
    - Stainless steel self-operated regulator
    - Flow max : 24 [m3/h]
    - Working temperature: 20°C
    - Outlet pressure: 10 bar
    - Differential pressure range: 10.5 bar (depending of the pump's curve)
- Emergency heaters specifications:
    - 3 x 12 kW + 1 x 9 kW thermo plungers in series
    - Power consumption: 45 kW

The pressure of the storage tank is controlled by a membrane vacuum pump and a pressure transmitter.

Storage tank capacity: 1. 5 [m3]

The cooling station and the manifold are stainless steel material as all the piping is realized with multi-layer PE/Alu/PE pipe and crimp fitting.

3.3 SUB-DETECTOR

Power and flow rate ($\Delta T = 6$)

	Rack platform 1 US side		Rack platform 7 US side		Rack platform 1 USA side		Rack platform 7 USA side		Total	
	Flow [m3/h]	Power [kW]	Flow [m3/h]	Power [kW]	Flow [m3/h]	Power [kW]	Flow [m3/h]	Power [kW]	Flow [m3/h]	Power [kW]
Barrel	1.36	4	1.36	4	1.36	4	1.36	4	5.44	16
Straw A, B, C	0.82	2.4	0.82	2.4	0.82	2.4	0.82	2.4	3.27	9.6
Wheel A	1.63	4.8	1.63	4.8	1.63	4.8	1.63	4.8	6.53	19.2
Wheel B	1.22	3.6	1.22	3.6	1.22	3.6	1.22	3.6	4.90	14.4
Wheel C	0.82	2.4	0.82	2.4	0.82	2.4	0.82	2.4	3.27	9.6
Total	5.85	17.2	5.85	17.2	5.85	17.2	5.85	17.2	**23.40**	**68.8**

(the 4 distribution racks are identical)

		Flow per line [l/h]	Per rack		Total	
			Number and Ø [mm]	Flow [l/h]	Number	Flow [l/h]
Barrel	Inlet	170	8 X Ø 11/12	1360	32 X Ø 11/12	5440
	Return	57.7	24 X Ø 7/8	1360	96 X Ø 7/8	5440
Straw A, B, C		102	8 X Ø 7/8	816	32 X Ø 7/8	3265
Wheel A		272	6 X Ø 11/12	1633	24 X Ø 11/12	6530
Wheel B		153	8 X Ø 11/12	1224	24 X Ø 11/12	4898
Wheel C		204	4 X Ø 11/12	816	16 X Ø 11/12	3265
Total						23400

(Each distribution rack is splitted in 2 parts: Inlet with 34 channels and Return with 50 channels due to the modularity of the barrel: 3 return lines for 1 inlet line)

3.4 C6F14

3.4.1 PROPERTIES OF C6F14

To avoid the catastrophic consequences of a water leak inside the ATLAS Tracker fluorocarbon C6F14 has been chosen as a safe coolant for the TRT detector.

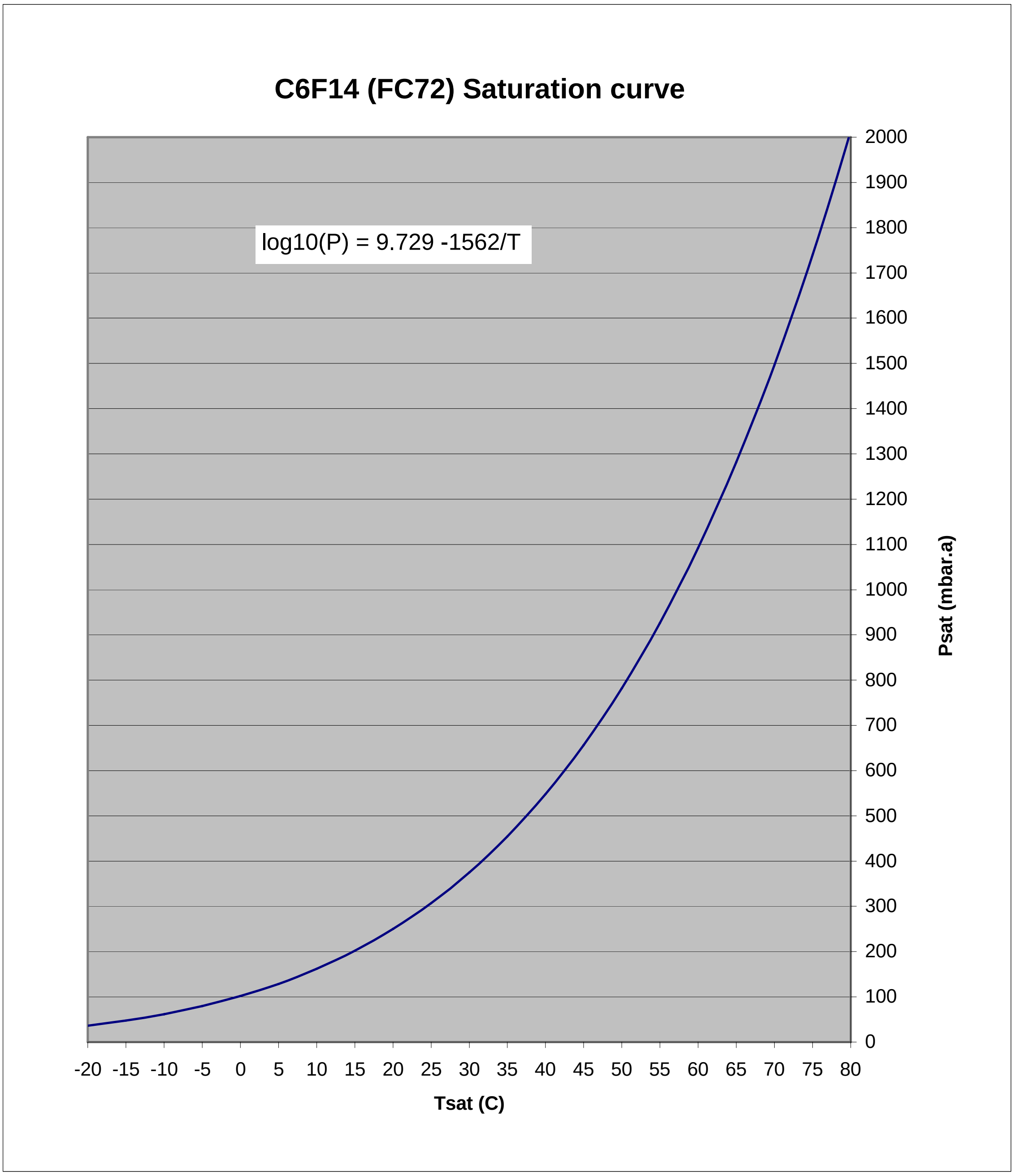
Fluorocarbons are a family of compounds containing carbon and fluorine only. Contrary to some classical refrigerants (HCFC or HFC) they do not contain Hydrogen. Under ionizing radiation HF acid may be formed so any H donor impurity (ex. Water) must be absent.

Advantages of fluorocarbons:

- High dielectric strength
- Good chemical stability under ionizing radiation
- Low toxicity and low corrosiveness
- Non-flammable
- Zero ozone-depletion potential – ODP
- Low global warming potential – GWP

Fluorocarbon	*PF5060 (FC72)*
Chem.formula	*C6F14*
Mean Mol.Wt.	*338*
Boiling point @1 atm [°C]	*56*
Dens.[g/cm3]	*1.68 @25°C*
Liquid DynamicViscosity [10^{-3} Pa.s]	*0.67 @25°C*
Liquid Kinematic Viscosity [10^{-6} m^2/s]	*0.4 @ 25°C 1.9 @-54°C*
Surface Tens.[dy/cm]	*12.0 @25°C*
Vapour press.@-10°C [Torr] [bara]	*58 0.077*
Latent Heat Vap. [J/mole] [kJ/kg]	*29670 88*
Specific Heat [kJ/kg.K]	*1.05*
Thermal conductivity [W/m.K]	*0.057*

Liquid-Gas Expansion Fact @ -10°C	*~1500*



t	ρ^0	ν	ν	μ^0	μ^0	Cp	k	Prandtl	β^0	σ^0	FOM
C	$kg{\cdot}m^{3}$	cSt	$m^2{\cdot}s^{-1}$	$kg{\cdot}m^{-1}{\cdot}s^{-1}$	cPoise	$J{\cdot}kg^{-1}{\cdot}C^{-1}$	$W{\cdot}m^{-1}{\cdot}C^{-1}$	°	C^{-1}	$N{\cdot}m^{-1}$	°
-30	1818.30	0.9354	9.35E-07	1.701E-03	1.70078	967.38	0	25.99	0	15.40	15507.96
-25	1805.25	0.8441	8.44E-07	1.524E-03	1.52384	975.15	0.062750	23.68	0.001446	14.93	16078.68
-20	1792.20	0.7660	7.66E-07	1.373E-03	1.37287	982.92	0.062200	21.69	0.001456	14.48	16631.77
-15	1779.15	0.6986	6.99E-07	1.243E-03	1.24296	990.69	0.061650	19.97	0.001467	14.02	17168.11
-10	1766.10	0.6400	6.40E-07	1.130E-03	1.13034	998.46	0.061100	18.47	0.001478	13.56	17688.26
-5	1753.05	0.5888	5.89E-07	1.032E-03	1.03212	1006.23	0.060550	17.15	0.001489	13.11	18192.44
0	1740.00	0.5437	5.44E-07	9.460E-04	0.94598	1014.00	0.060000	15.99	0.001500	12.67	18680.68
5	1726.95	0.5038	5.04E-07	8.701E-04	0.87008	1021.77	0.059450	14.95	0.001511	12.22	19152.80
10	1713.90	0.4685	4.68E-07	8.029E-04	0.80293	1029.54	0.058900	14.03	0.001523	11.78	19608.49
15	1700.85	0.4370	4.37E-07	7.433E-04	0.74329	1037.31	0.058350	13.21	0.001535	11.34	20047.33
20	1687.80	0.4089	4.09E-07	6.902E-04	0.69016	1045.08	0.057800	12.48	0.001546	10.91	20468.89
25	1674.75	0.3837	3.84E-07	6.427E-04	0.64266	1052.85	0.057250	11.82	0.001558	10.47	20872.67
30	1661.70	0.3611	3.61E-07	6.001E-04	0.60010	1060.62	0.056700	11.23	0.001571	10.04	21258.20

3.4.2 COMPATIBILITY OF C6F14 WITH MATERIALS

Note: one should avoid plastics with the fluorocarbons as they take out the plastiziser and the product becomes brittle. Source: G. Lenzem, DELPHI RICH and 3M

M. Capeans, Nov.2001

C6F14 - O-rings

Suggested by 3M as best choices

	Rad Hard	Compatibility	GLOBAL RESULT
EPDM	**< 10^8 rad** (Data: CERN 82-10)	**OK** (Data: 3M)	OK
Perbunan (NBR) or caoutchouc or nitrile rubber	**10^8 rad** (Data: CERN 82-10)	**OK** (but some effect) (Data: 3M)	OK
Neoprene	**10^7 rad** (Data: CERN 82-10)	**OK** (Data: 3M)	OK
Butyl rubber	< 10^5 rad (Data: CERN 82-10)	**OK** (Data: 3M)	BAD
PVDF	**10^8 rad** (Data: Angst+Pfister)	**OK** (but some effect) (Data: 3M)	OK
Kalrez	**10^6 rad** (Data: CERN 82-10		
Viton	**< 10^7 rad** (Data: CERN 82-10)	**BAD** (Data: 3M)	BAD *
Teflon (PTFE & PCTFE)	**BAD**	**BAD**	BAD

* Viton O-rings were used in DELPHI with no leak problems. Source: G. Lenzem, DELPHI RICH

3.5 COOLING PLANT DRAWINGS

3.6 CIVIL ENGINEERING INTEGRATION

See drawings in CDD:

- **Civil Engineering - Package 1 - Underground**
    - Civil Engineering – UX15

The services required by this cooling plant are:

- 10 m^3/h of chilled water
- 67 kW, 400V from the standard power distribution
- 850 W, 220V from the UPS power distribution
- Compressed air at 6bar (consumption is negligible).
- TCP/IP connection(s)

4. USER MANUAL

4.1 INTRODUCTION

This user manual concerns the use of the PLC interface panel on the control rack FCTIR-00015. The normal operation of the TRT cooling plant is done via PVSS logistic situated in CERN Experimental Control Room (ECR). The XBT panel can be operated only when being authorized from the PVSS logistic.

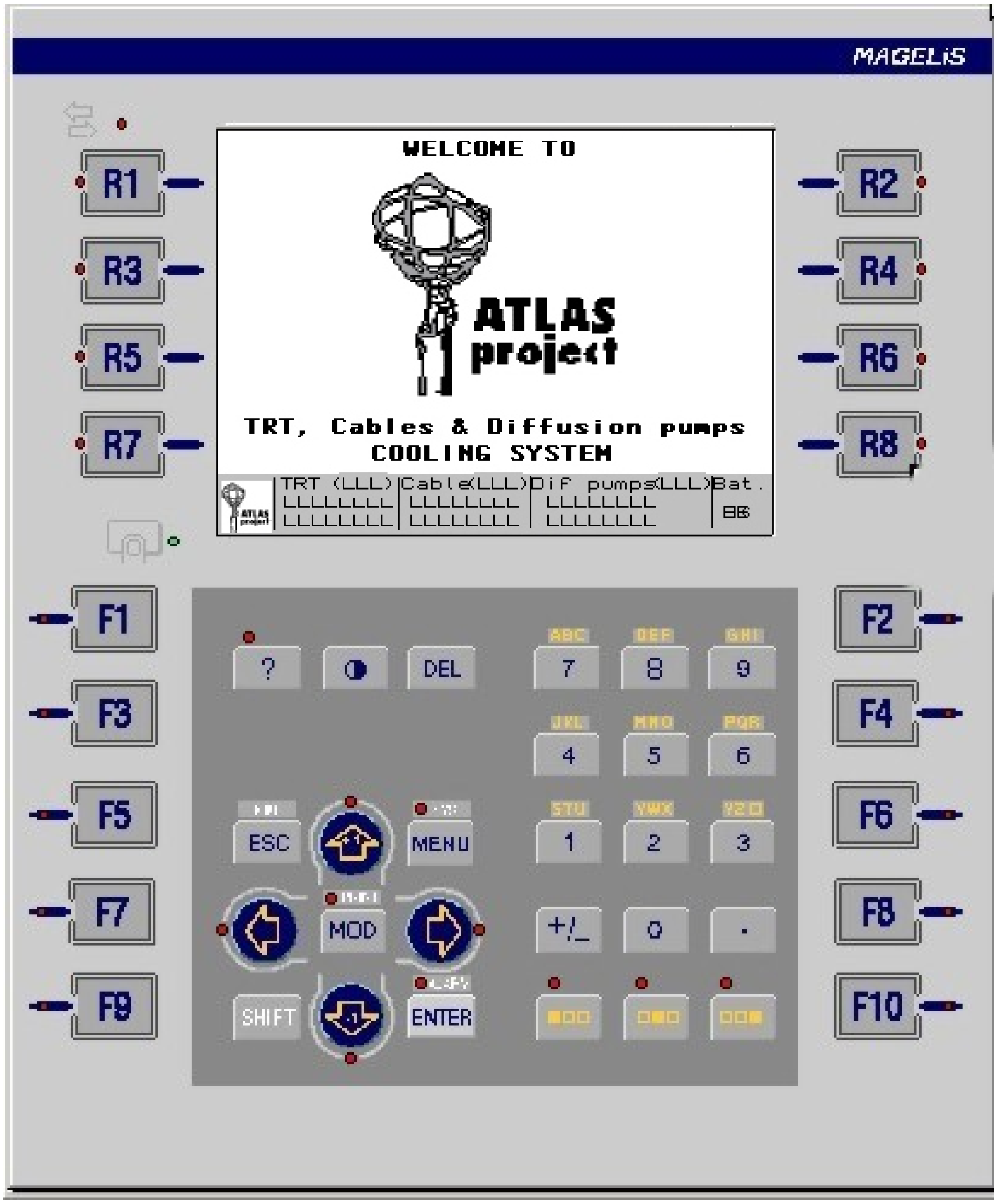


Figure 4.1.1 XBT-Magelis Interface Panel

The PLC handles the functions of three different cooling units in UX15 and USA15 (TRT, Cables and Diffusion Pumps). The main page of the XBT is shown on the Figure 4.1.1.

The XBT panel functions with two different sets of buttons, on top the R1 to R8, which operates different functions seen on the display (functions change depending on the display). The buttons below, F1 to F10 operates the main functions that can be found below.

F1	Main page	**F2**	TRT cooling system front page
F3	System designed by	**F4**	Cables cooling system front page (Chap.4.2)
F5	Faults and status (Chap.4.5)	**F6**	Rod Racks cooling system front page
F7	Sensors calibration (Chap.4.6)	**F8**	Empty
F9	Empty	**F10**	Reset

4.1.1 KEYBOARD

The keyboard of the XBT interface panel is according to the figure 4.1.1.1

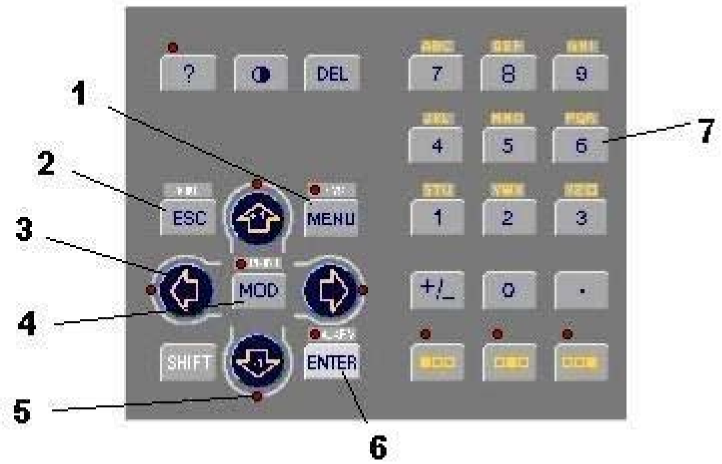


Figure 4.1.1.1 Keyboardl

1: **Menu** – see chapter 4.7

2: **ESC** – move back to the previous page

3: **Arrow keys** that you can use to navigate in the menus

4: ***MOD*** to modify parameter

5: Small **led lights** indicate when the button next to it is operational

6: Validate your choice by hitting ***Enter***

7: **Number keys** 0 to 9 that you can use e.g. to insert the password or set points.

4.2 TRT CONTROL / F4

Access to the Liquid Argon cooling control system happens by pressing key “TRT” (F4). The display will show the view below (figure 4.2.1).

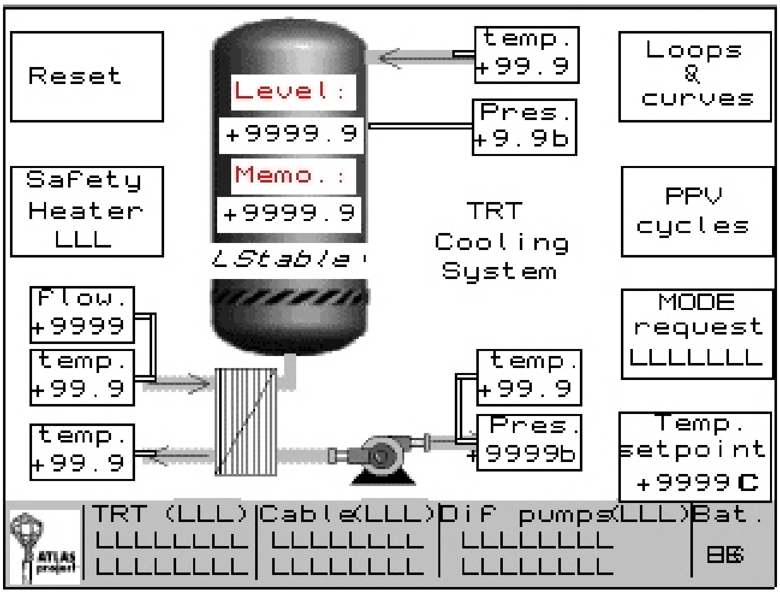


Figure 4.2.1 TRT front page

The TRT front page shows following values of the cooling system:

- Primary network (chilled water) flow [m^3/h]
- Primary network (chilled water) inlet temperature (before the heat exchanger) [°C]
- Primary network (chilled water) outlet temperature (after the heat exchanger) [°C]
- Secondary network (C6F14) return temperature (before the storage tank) [°C]
- Secondary network (C6F14) inlet pressure (before the storage tank) [bar(a)]
- Secondary network (C6F14) tank level in the storage tank [l]
- Secondary network (C6F14) memorized tank level in the storage tank [l]
- Secondary network (C6F14) conductivity level [uS/cm]
- Secondary network (C6F14) outlet temperature (after the storage tank) [°C]
- Secondary network (C6F14) outlet pressure (after the storage tank) [bar(a)]
- Secondary network (C6F14) set-point temperature (after the storage tank) [°C]

The screen has on its right side following functions:

- loops and curves (operates by pressing button R2)
- PPV cycles (operates by pressing button R4)
- MODE request (operates by pressing button R6)
- Temp. set point (operates by pressing button R8)

All pages displayed on the screen after the main page bear information on the Cycle and the Status. The former can assume 3 different values: Stop, Stand-by, and Run. The latter can either display OK, Warning or Alarm.

The default Cycle when the plant is powered ON is STOP. In this cycle the circulator pump is idle; all circuits (supply and return valves) are closed; the reservoir is at atmospheric pressure; the chilled water valve is closed.

When the plant is powered ON, the Status is likely to be indicating ALARM. The exact list of alarms can be obtained by pressing F5 – faults and status (see chapter 4.5).

4.2.1 LOOPS AND CURVES

When button R2 – TRT loops and curves is pressed the following display (Figure 4.2.1.1.loops and curves) will appear on the screen.

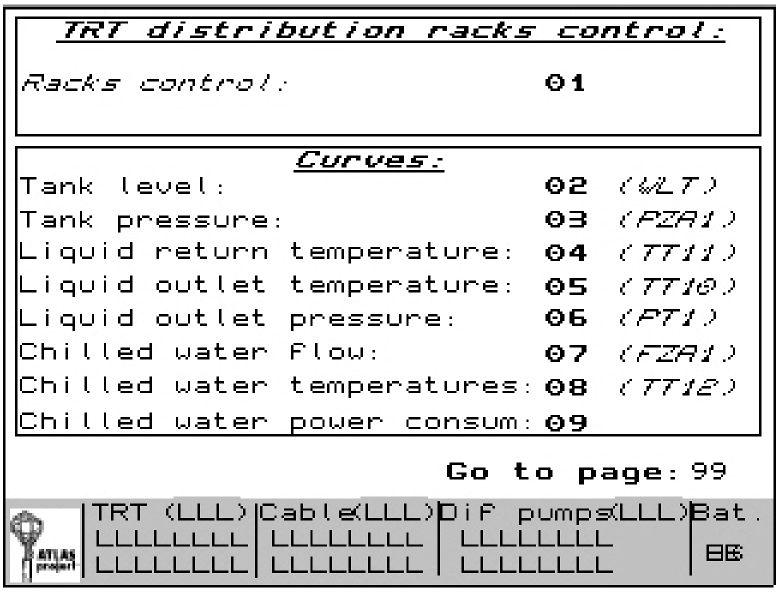


Figure 4.2.1.1 loops and curves

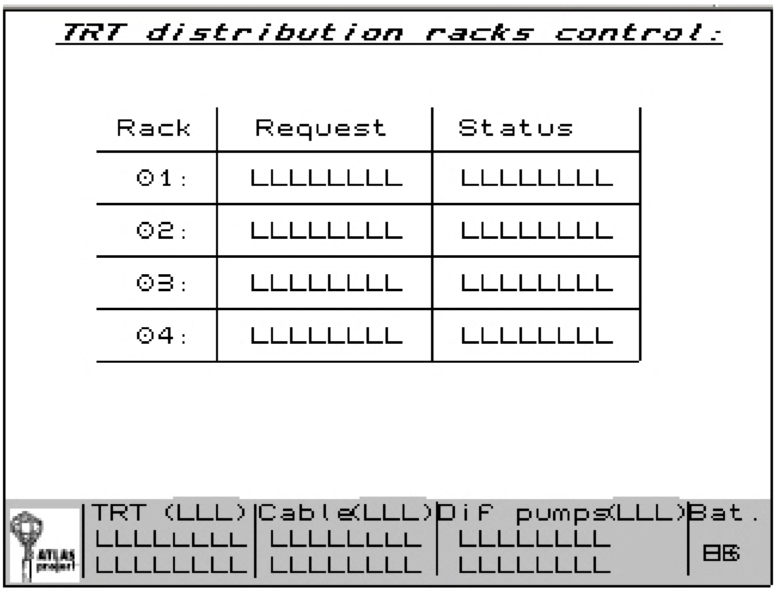


Figure 4.2.1.2 Distribution racks control

Press the button R8 to have the access on the screen. There will be a rectangular box appearing where the number of the wanted loop or curve is to be written (next to the text 'Go to page'). Insert the number using the number keys, and press enter.

The loops and curves display allows the access to the 24 different cooling loops of the cooling system (see chapter 3 and the drawings Annex A). The PLC shows the pressure of the cooling loop during the last 24 hours which can be seen on the display. There is also access to the different measuring points of the cooling station (curves 25 to 32 according the figure 4.2.1.1). Below you have two examples, Figure 4.2.1.2 TRT loop 01, and Figure 4.2.1.3 TRT – Tank level.

The curves and loops can be viewed without a password. In order to change the settings of the curves and loops you need to insert the **USER** password. The **USER** password can be inserted from the menu (see chapters 4.1.1.keyboard and 4.7.MENU).

For more detail on the loops control see chapter 4.3. COOLING SETTINGS.

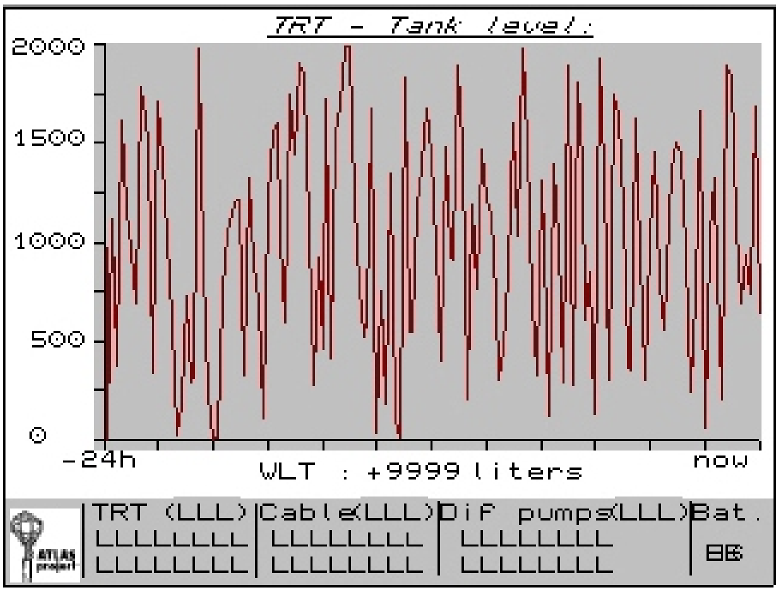


Figure 4.2.1.3 TRT – Tank level

4.2.2 PPV CYCLES

When button R4 – PPV cycles is pressed the following display (Figure 4.2.2.1 PPV cycles) will appear on the screen.

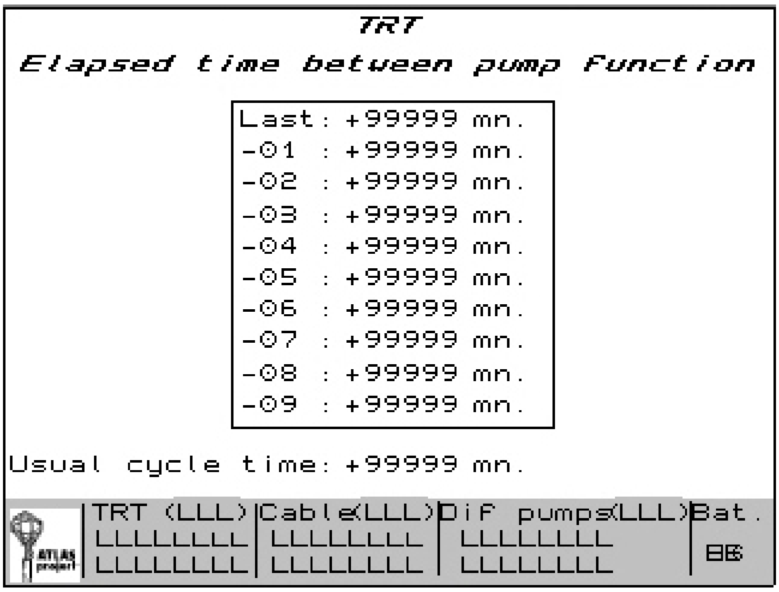


Figure 4.2.2.1 PVV cycles

The display shows the elapsed time between the vacuum pump cycles. Here some of the possible leaks (air infiltration) in the cooling system can be seen.

4.2.3 MODE REQUEST

From here, using the **MAINTENANCE** password, you can manage the current function of the cooling station. There are three different functions.

1) Stop
2) Stand-by
3) Run

You need to insert the **MAINTENANCE** password before you can operate this function. The **MAINTENANCE** password can be inserted from the menu (see chapters 4.1.1.keyboard and 4.7.MENU).

When button R6 – MODE request is pressed the display (Figure 4.2.1.TRT front page) will not change. A rectangular box below the text ‘MODE request’ will start plinking. The cooling station mode can now be changed using the arrow keys.

The cooling station operation is more precisely described in the chapter 4.3.Cooling Settings.

4.2.4 TEMPERATURE SET-POINT

From here you can manage the outlet cooling liquid temperature that is going to the detector. You need to insert the **USER** password before you can operate this function. The **USER** password can be inserted from the menu (see chapters 4.1.1.keyboard and 4.7.MENU).

When button R8 – 'Temp. setpoint' is pressed the display (Figure 4.2.1.TRT front page) will not change. A rectangular box below the text 'Temp.setpoint' will start plinking. Now you can change the temperature set point using the number keys.

The temperatures can be set between 16 and 20 degrees. The cooling system operates with one uniform temperature. If you change the temperature of one of the cooling loops, you will change the temperature of all the cooling loops at the same time.

4.3 COOLING SETTINGS

4.3.1 STARTING COOLING

The cooling mode can only be changed using **MAINTENANCE** password. The **MAINTENANCE** password can be inserted from the menu (see chapters 4.1.1.keyboard and 4.7.MENU).

The cooling can only be started at the stand-by mode. If the system is stopped, you need first to go in the stand-by mode from the TRT front page – mode request (See chapter 4.2.3). Before starting the system you have to wait that the vacuum in the storage tank is at 400 mbar (a).

Upon selecting the **RUN** Cycle, the circulator pump starts working and the chilled water valve begins cooling the heat exchanger. This temperature regulation is piloted by a PID control algorithm. The set points for these closed-loop controls are operated according to the chapters 4.2.4 TEMPERATURE SET-POINT, and 4.2.1 LOOPS AND CURVES.

If all the cooling circuits are closed or locked when the circulator pump starts working (i.e. when the RUN Cycle is selected), the by-pass regulation valve shall divert the flow from the supply manifold to the return manifold. Starting pumping through the by-pass before opening any circuit is in fact the safest way to proceed, as it will prevent any initial pressure or temperature spike to propagate to the detector.

4.3.2 COOLING SETTINGS

Given the correlation between flow rate and pressure (loosely ΔP~FlowRate2), the user should turn his attention to the exact cooling circuits he plans to flow water through. This is done by hitting the "Loops and curves" keys on the panel Chapter 4.2.1 LOOPS AND CURVES.

You need to insert the **USER** password before you can operate cooling settings. The **USER** password can be inserted from the menu (see chapters 4.1.1. keyboard and 4.7. MENU).

The cooling loops have to be viewed separately. You can move from one loop to the next one by pressing the key F8. With the **USER** password you can operate the pressure set point of the loops, and the state of the loops.

Any given cooling loop can display one of three states:

- **Locked**: supply and return valves are closed. This is the state you should select only in case of major leak on the loop.
- **Open**: supply and return valves are open.
- **Closed**: supply valve is closed but return valve is open. Select this state if the plant is in ***Stand-by*** and you intend to **open** the circuit once the plant is in ***Run*** (the reason for this is explained in §5.3). This is also the state in which a circuit should remain if it is piped to the detector and contains water left inside. By letting the return valve open, the whole circuit will be kept below atmospheric pressure and thereby prevent any liquid spill out through possible leaks in the detector.

When a cooling circuit changes from locked to open, there is a 6 sec time delay between the opening of the return and the supply valve. Similarly, when a open circuit is to be locked, the return valve is shut 6 sec after the supply valve.

Note that when the cooling plant is in Stand-by, the pressure in the reservoir is kept sub-atmospheric by a vacuum pump. This pressure is controlled by switching ON the vacuum pump when the pressure surges 50mbar and OFF when it is back at its set point. Therefore, when the volume of a cooling circuit is for the first time put in contact with the reservoir volume, (example: locked ☐ closed or locked ☐ open), the vacuum pump will have to remove that additional air from the reservoir.

4.3.3 MONITORING OF PARAMETERS

Real time information on the main parameters of the cooling plant can be viewed on the TRT front page. The parameters of the 24 cooling loops to the detector can be viewed at the loops and curves, chapter 4.2.1.

4.3.4 STOP PROCEDURE

The **MAINTENANCE** operator can select Stop from any of the other cycles. When doing so, the circulator pump stops, the chilled water, the supply valves shut and the return valves open. The negative pressure in the reservoir is no longer maintained.

The cooling plant can remain safely in ***Stand-by*** or ***Stop*** and it should not be powered off.

4.4 THE "LEAKLESS" PROTECTION

When the cooling plant is in Stand-by, the whole system (plant + piping + detector) is below atmospheric pressure whereas in Run, only the return pipes and eventually part or the detector is in negative pressure. Therefore, should a leak occur, it may lead to air infiltration.

Liquid leakage can happen only when the system is operated at run mode.

4.4.1 LIQUID LEAKAGE

A liquid leak can be detected and stopped early in time. This is done by continuously measuring the liquid level in the reservoir and stopping the circulator pump when a significant drop is detected. As soon as the pump stops, the sub-atmospheric pressure prevails throughout the whole system (system = cooling plant + piping + detector), thereby stopping the liquid spillage.

The liquid level in the reservoir may drop without necessarily meaning that liquid is lost somewhere. This the case when the plant goes from Stand-by to Run and/or when cooling(s) circuits are put into service (more liquid leaves the reservoir to fill-up new volumes outside the plant) or when the pumped flow varies (altering the pressure set point). It is quite often the case that air trapped inside the detector piping itself takes time to be flushed down to the reservoir, so new volumes of liquid are still being filled outside the plant, long after the pumping has started. These liquid level disturbances (opening circuits, pump start/stop and change of flow throughout) are acknowledged by the PLC and do not set off the Fast Liquid Level Change ALARM. However, after one of these disturbances has occurred, the PLC needs to rememorize a new stable level. The level is considered suitable to be memorized if it remains within a +- 5L margin of a given level for the 15 minutes following the reading of that level. Once a new level is memorized, the surveillance is reactivated and any level drop of more than 100L will give rise to the Fast Liquid Level Change ALARM and take the system to Stand-by.

The evolution of liquid level during all these events is shown below:

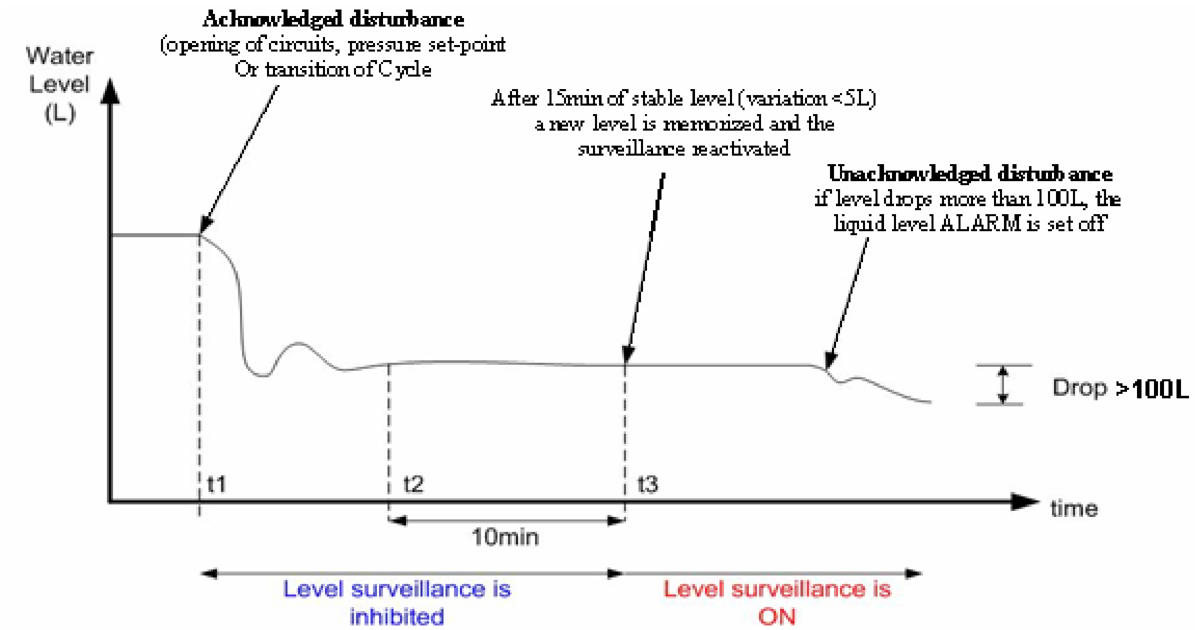


Figure 4.4.1.1 Normal and abnormal variations of the liquid level in the reservoir

During the surveillance inhibition period, the ***Level stability Fault*** will appear (Faults & Warnings page). Once the Level surveillance is back on, this fault will disappear.

4.4.2 AIR INFILTRATION

Air infiltration is not a problem but may become one if it is big enough. It may equalize the pressure to atmospheric and thereby allow liquid to spill out.

In case of a major air infiltration causing the air pressure to rise above 0.9bar, the Pressure Fault will appear in the Warnings page and the circulation pump stops (if the plant happens to be in Run at that moment). When the pressure drops below 0.9bar the circulation pumps restarts.

However, after 20 minutes of continuous vacuum pump working, the Vacuum pump timing ALARM will make the system go to Stand-by (thus bringing the circulation pump to a definitive halt). Note however that in Stand-by mode the reservoir pressure regulation is still ON, so the vacuum pump carries on working to bring the pressure down to the set point if possible.

4.5 FAULTS AND ALARMS - F5

By pressing F5 on the main page you can manage the faults and alarms of all three the cooling systems. Alarms can be reset by pressing key F10.

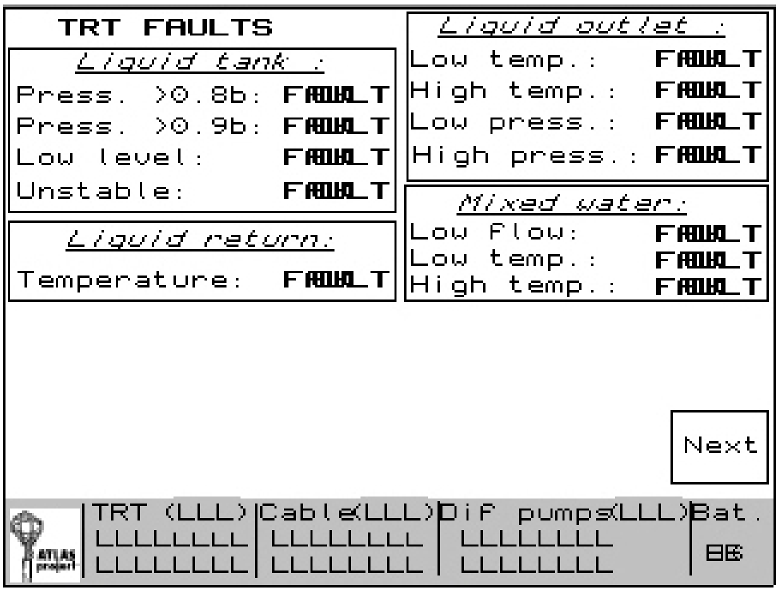


Figure 4.5.1 Faults

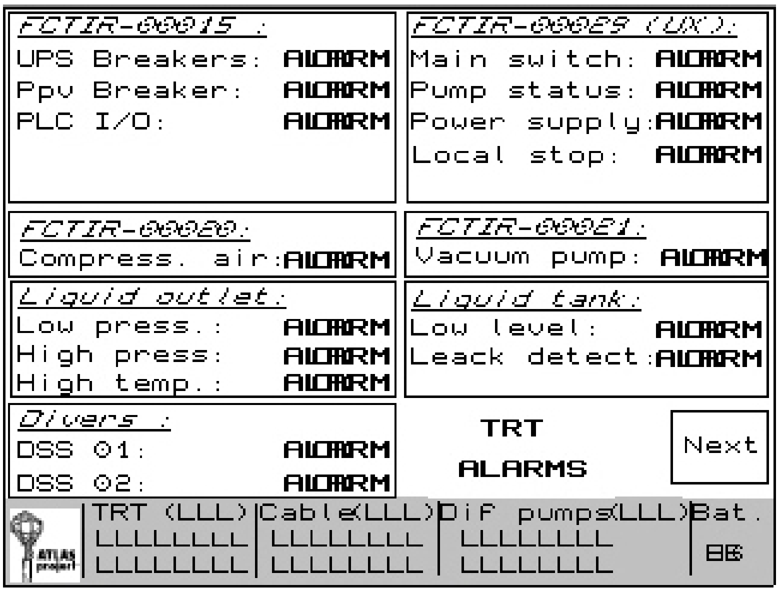


Figure 4.5.2 Alarms

The first two views that appear on the screen is TRT cooling system faults pages. By pressing the button R8 – 'Next', you move on the next page. The TRT cooling system has two pages like ID Cables and Diffusion Pumps (the other systems after TRT).

In general, a FAULT occurs when a continuous variable (pressure, temperature, flow) goes beyond a defined threshold. If the variable attains a second threshold, then the FAULT turns into an ALARM. For some continuous variables however, only ALARM or FAULT thresholds were defined. Obviously, this is also the case for binary (boolean) variables (pressure switches, shut off valves, circuit breakers etc). Once the origin of a FAULT has been corrected (i.e. the variable is back within its normal range or to its normal logical value) the indication OK appears by itself.

Once the origin of an ALARM has been corrected, the user must push the Reset button on the panel and only then the indication OK appears.

IMPORTANT:

- **An Alarm should only be reset after its cause has been fully understood.**
- **If the Alarm persists after it has been reset, do not keep on pushing the Reset button repeatedly as this may damage the cooling plant.**
- **The system can be reset only three times consequently.**

4.5.1 LISTE OF FAULTS AND ALARMS

Fault	**Cause**	**Outcome**	**Cycles in which it is active**		
			Stand-by	**Run**	**Stop**
Liquid outlet: Temp. < 16°C	The temperature of the water at the supply manifold is below 16ºC	none		•	
Liquid outlet: Temp. > 24°C	The temperature of the water at the supply manifold is above 24ºC	none		•	
Liquid outlet: Low press.	The pressure at the supply manifold is below 1.2 bar(a).	none		•	
Liquid outlet: High press.	The pressure at the supply manifold is above 6.0 bar(a).	Halts circulator pump		•	
Chilled water: temp<8°C	The chilled water temperature is lower than 8ºC.	none	•	•	•
Chilled water: temp>17°C	The chilled water temperature is higher than 17ºC.	none	•	•	•
Chilled water: Flow<20L/h	The chilled water flow is lower than 20L/h.	none	•	•	•
Liquid Tank: Pressure	Air pressure in the reservoir is above	Halts circulator		•	

	0.9 bar(a).	pump (if in Run)			
Liquid Tank: Pressure	Air pressure in the reservoir is above 0.8 bar(a).	none	•	•	•
Liquid Tank: Level<100L	The volume of water in the reservoir is less than 100L.	none	•	•	•
Liquid Conductivity level: Level>0.7mS	The water conductivity rises over 0.7mS.	none	•	•	•
Loop max. pressure: Level 1.2 bar(a)	The pressure at the cooling loop rises above 1.2 bar (a).	Closes the loop		•	
Liquid Tank: Level stability	Following an acknowledged disturbance, the level surveillance is inhibited while a new stable level is being memorized.	none	•	•	•

Alarm	**Cause**	**Outcome**	**Cycles in which it is active**		
			Stand-by	**Run**	**Stop**
Compress air fault	The pneumatic supply pressure is below limit.	Goes to Stand-by		•	•
Breakers fault 1-3	The circuit breakers of the UPS power supply tripped	Goes to stand-by	•	•	
Breakers fault 4-6	The main circuit breakers tripped	Goes to Stand-by	•	•	
Liquid Pump power supply failure	The liquid pump power supply failure	Goes to Stand-by		•	
Liquid Pump Failure	The liquid pump failure	Goes to Stand-by		•	
Low outlet Pressure	Following the fault threshold at 1bar(a), the pressure has now dropped below 0.8bar(a)	Goes to Stand-by		•	
High outlet Pressure	Following the fault threshold at 6.0bar(a), the pressure has now surged above 8.0bar(a)	Goes to Stand-by		•	
Tank liquid level	Following the fault threshold at 100L, the level has further dropped below 50L.	Goes to Stand-by	•	•	
Fast Liquid level change	Following an unacknowledged disturbance, the level drops more than 100L	Goes to Stand-by	•	•	
Chilled water temperature > 25ºC	If the chilled water supply is at a temperature higher than 25ºC for more than 2min	Goes to Stand-by		•	
Vacuum pump timing	Vacuum pump works continuously for more than 20min	Goes to Stand-by	•	•	

Alarm	Cause	Outcome	Cycles in which it is active		
			Stand-by	Run	Stop
PLC I/O failure	Processor watchdog out of range input signal	Goes to Stop	•	•	
Local equipment stop	System shut-down from red button on the cooling system in UX15	Goes to Stop	•	•	
DSS interlock	DSS connection requests	Goes to Stop	•	•	

4.6 SENSORS CALIBRATION – F7

From here you can manage the calibrations of the pressure and temperature sensors (only in the case of replacing a sensor). You need to insert the **MAINTENANCE** password before you can operate this function. The password can be inserted from the menu (see chapters 4.1.1.keyboard and 4.7.MENU).

When button R8 is pressed (Figure 4.6.1 Sensors calibration) a rectangular box next the text 'Go to page' will start plinking. Now you can choose which sensors you want to calibrate.

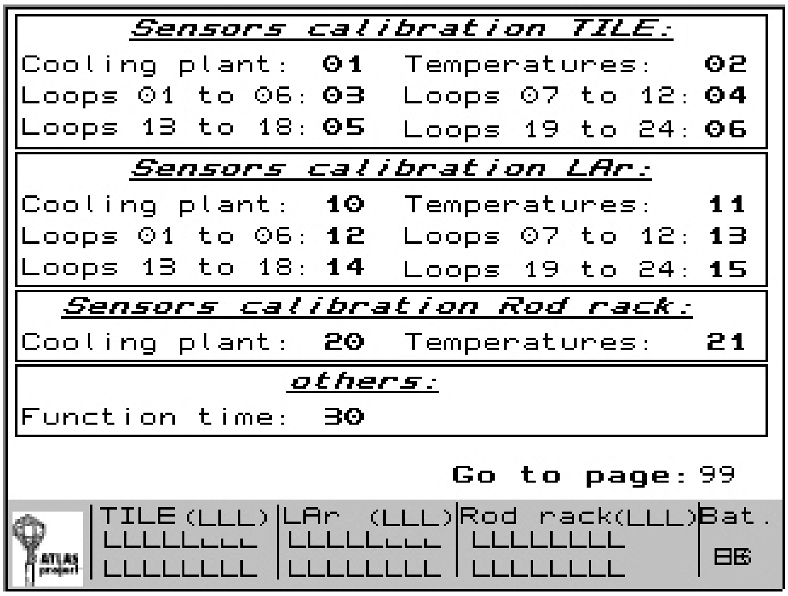


Figure 4.6.1 Sensors calibration

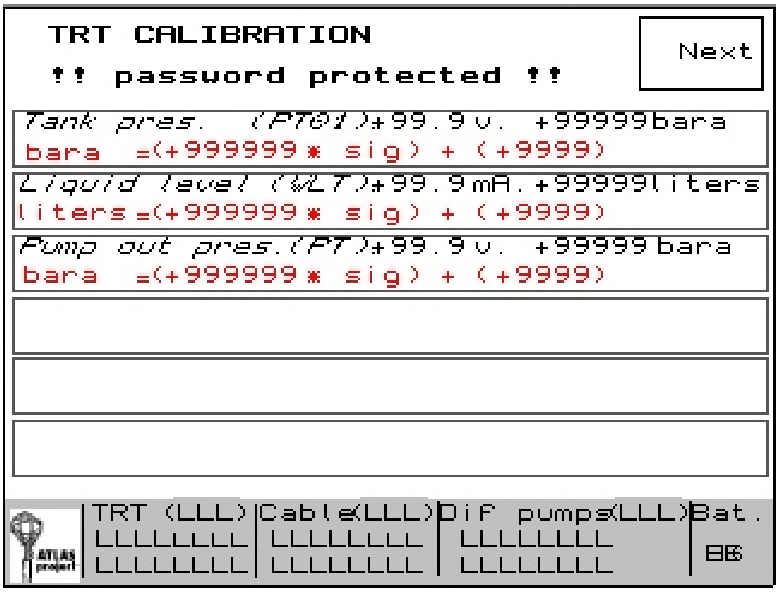


Figure 4.6.2 Sensors calibration / page 01 **1/2**

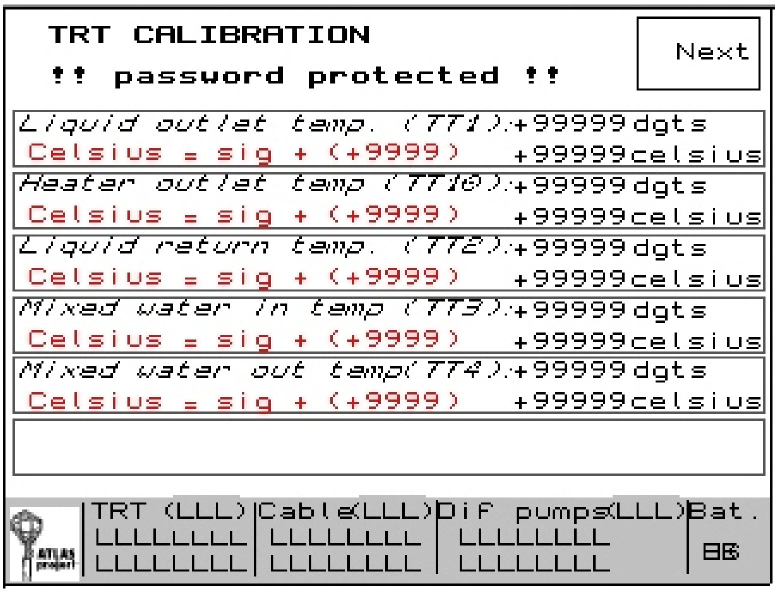


Figure 4.6.3 Sensors calibration / page 01 **2/2**

4.7 MENU

When button MENU on the keyboard is pressed the following display (Figure 4.7.1.MENU) will appear on the screen.

Figure 4.7.1 Menu display

Use the buttons R1 to R8 to enter to the different menus. The functions R3, R4 and R5 do not function.

4.7.1 LISTE DES PAGES – R1

This page contains all the pages on a number order.

4.7.2 LISTE DES ALARMES – R2

This page contains all the active alarms on a number order that they have appeared. You have also the time that each of the alarms have appeared. See chapter 4.5 Faults and Alarms.

Figure 4.7.2.1 List of alarms

You can access the different alarms using the arrow keys up and down on the keyboard (the red led light is lighted when the button is in operation). Using the arrow key right, you can access the help display, where the cause of the alarm is more precisely explained (see the figure 4.7.2.2 below).

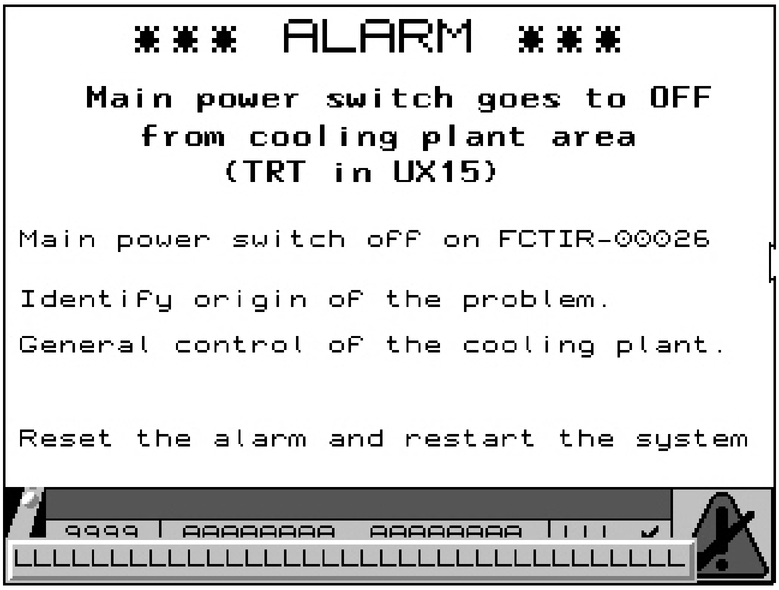


Figure 4.7.2.2Alarm help page

4.7.3 LISTE DES RECETTES – R3

This page does not function for the moment.

4.7.4 HISTORIQUE DES ALARMES – R4

This page contains the history of the alarms. You can see the times of the appearances and resets of the alarms at their proper order.

Figure 4.7.4.1 History of alarms

4.7.5 LISTE DES FORMULAIRES – R5

This page does not function currently.

4.7.6 ARRET DE L'IMPRESSION – R6

This page does not function currently.

4.7.7 MOT DE PASSE – R7

On this page you can insert the user or maintenance password.

Figure 4.7.7.1 Password

4.7.8 ESC – R8

Use the button to go back on the previous page.

4.8 TIME AND DATE

In case of a power cut, the XPT looses the memory of the time and the date. In order to maintain a clear history of the alarms, the time and the date should be updated.

When buttons SHIFT + MENU are pressed at the same time the following display (Figure 4.8.1.SYSTEM) will appear on the screen. Pressing R1 – Parameters terminal gives access to change the time and the date on the XPT.

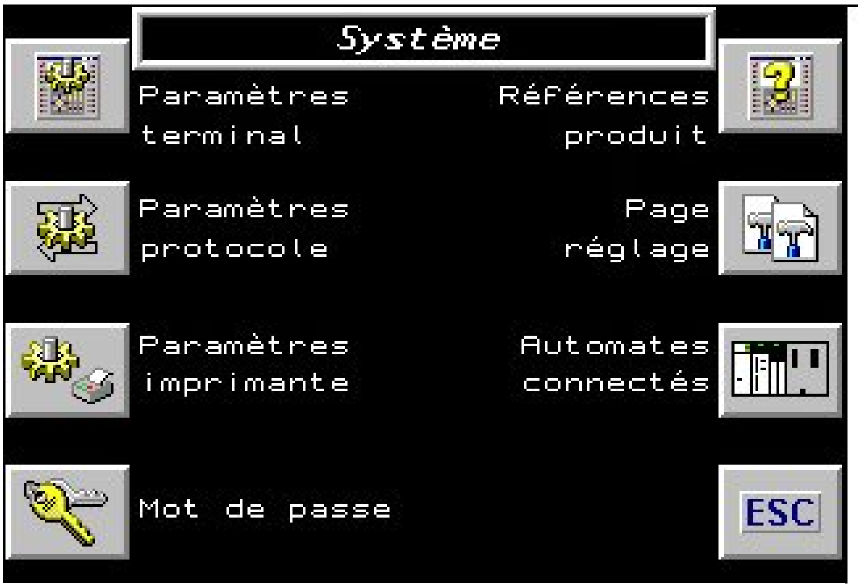


Figure 4.8.1 System

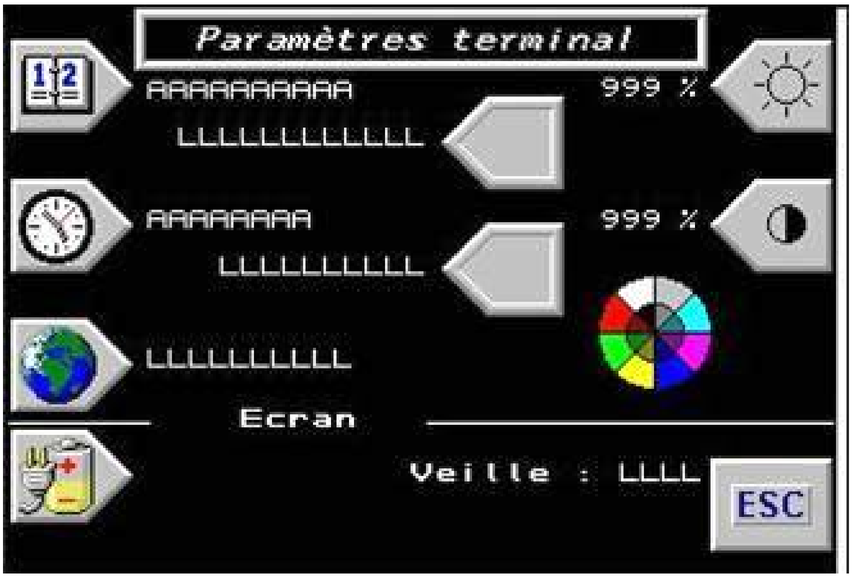


Figure 4.8.2 Terminal parameters

On the figure 4.8.2 Terminal parameters, the date can be changed by pressing R1. The time can be changed by pressing R3.

5. COMPONENT DOCUMENTATION

5.1 COMPONENT DATA

List of components is done according to chapters :

- 2.2 General naming,
- 3.5. Cooling plant drawings

See component data sheets in Annex B, and DAI-documents in Annex C.

5.1.1 BALANCING VALVE (BAV)

The balancing valves (BAV) are TA Hydronics model STADA. See DAI/1791532 and the user manual in Annex B.

5.1.2 BUTTERFLY VALVE (CBV)

The butterfly valve DN80 (CBV) is Tyco model Tyco Keystone no.425T80. See DAI/1813909.

5.1.3 CONVERTER ELECTROPNEUMATIC (CEP)

The electro pneumatic converter (CEP) is Samson regulation model 6111 with 4-20mA. See DAI/1731032 and the user manual in Annex B.

5.1.4 CHEMICAL FILTER (CF)

The chemical filter (CF) is Danfoss model DCR-9617 ref.23U7064, and the filter cartouches type C48XH art no. WC48XH. See DAI/1795118 and the user manual in Annex B.

5.1.5 DIFFERENTIAL PRESSURE REGULATOR (DPR)

The differential pressure regulator (DPR) is Sart Von Rohr Model 5362L4 – DN40 PN40. See DAI/1813161 and the user manual in Annex B.

5.1.6 ELECTROVALVE 2 WAYS (EVB)

The Electrovalves (EVB1 to EVB28) are Asco Joucomatic model Ilots Compact 8 profibus-DP. See DAI/1795827 and the user manual according Annex B.

5.1.7 SIGHT FLOW GLASS (FSG)

The sight flow glasses (FSG) are Ribat model Meca-Inox. See DAI/1791532, DAI/1963005 and the user manual in Annex B.

5.1.8 FLOW METER (FZA)

The flow meter (FZA) is Actaris model Woltman type Nr.120205. See DAI/1808620 and the user manual in Annex B.

5.1.9 HEATER (HEA)

The heaters (HAE) are Cetal models 77 C 16 120 (12kW) 3 pc's and 77 C 16 090 (9kW) 1 pc. See DAI/1813591 and the user manual in Annex B.

5.1.10 HEAT PLATE EXCHANGER / CHILLED WATER (HPX)

The heat exchanger (HPX) is Swep Ag Art No. 10877-090. The heat exchanger total power is 70kW at 5/11°C (primary) and 14/20°C (secondary) with flow rates of 10 m3/h (primary and 23.8m3/h (secondary). See DAI/1817922 and the user manual in Annex B.

5.1.11 MECANICAL FILTER (MF1)

The mechanical filter for compressed air is Tri-matic model 5000 Nl/min, 1st stage. See DAI/1913327 and the user manual in Annex B.

5.1.12 PNEUMATIC CONTROL VALVE 2 WAYS (PCVA1)

The pneumatic control valve (PCVA1) is Sauter Controls model V6F50 type F304 with pneumatic actuator (Kvs 40). See DAI/1816843 and the user manual in Annex B.

5.1.13 MANOMETER (PG)

See MAG/1826202 (-1-5bar and -1-10bar), MAG/2064973 (-1-1bar), DAI/2082462 (0-6bar and -1-1.5bar), DAI/2293657 (-1-1.5bar) and the user manual in Annex B.

5.1.13.1 PG -1 TO 1 BAR

The manometers -1 to 1 bars are model CERN, SCEM: 22.41.21.350.9 MANOMETER Ech.-1-1bar D100.

5.1.13.2 PG -1 TO 5 BAR

The manometers -1 to 5 bars are model CERN, SCEM: 22.41.21.300.9 MANOMETER Ech.-1-5bar D100.

5.1.13.3 PG -1 TO 10 BAR

The manometers -1 to 10 bars are model CERN, SCEM: 22.41.21.310.7 MANOMETER Ech.-1-10bar D100.

5.1.13.4 PG 0 TO 6 BAR

The manometers 0 to 6 bars are Manometer Ag model no. art 9204436.

5.1.13.5 PG -1 TO 1.5 BAR

The manometers -1 to 1.5 bars are Manometer Ag model no. art 9640339.

5.1.14 PRESSURE REGULATOR (PR)

The pressure regulator for compressed air electro valves (PR1) is Tri-matic model One 8 bar. See DAI/1913327, and the user manual in Annex B.

5.1.15 PRESSURE SWITCH (PST2)

The pressure switch for compressed air (PST2) is Tri-matic model One 2 bar. See DAI/1913327 and the user manual in Annex B.

5.1.16 PRESSURE TRANSMITTER (PT)

The pressure transmitters (PT) are Huba Control model 680 range 0-2.5 bar.a, 4-20mA, model 680 range 0-10 bar.a, 4-20mA, and model 680 range 0-16 bar.a, 4-20mA. See DAI/1727519 and the user manual in Annex B.

5.1.17 PNEUMATIC VALVE 2 WAYS (PVA)

The Pneumatic valves (PVA) are the supply and return valves on the cooling unit in UX15. The return valves are ribat model stainless steel ball valve 316 with spring return actuator, normally open, the supply valves same with a difference of normally closed. See DAI/1836537 and the user manual in Annex B.

5.1.18 RELIEF VALVE (REV)

The relief valve for the storage tank is REV1 100mbar, NPT ½"M is model CERN, SCEM: 40.10.30.508.9 Circle CH.valve.3000 PSI ½ NPT. See MAG/1826202, MAG/2286397 and DAI/2082473 and the user manual in Annex B. The relief valve after the pump is not yet bought.

5.1.19 STRAINER (STR)

The strainer (STR) is a Tecofi models F6240 with tami-moleculer filters. See DAI 1796845 and the user manual in Annex B.

5.1.20 STORAGE TANK (STT)

The storage tank is a 3.5m3 stainless steel tank fabricated by SODEC SA. See DAI/1816235 and the chapter 3.4. Cooling plant drawings / Drawing COOLING STATION TRT TANK 3500 LITERS - EDMS818016.

5.1.21 TEMPERATURE TRANSMITTER (TT)

The temperature transmitters PT100 (TT) are Thermo-Est model SI 1119F/L/3F/A Class A, range 0-100°C. See DAI/1813331 and the user manual in Annex B.

5.1.22 HORIZONTAL CENTRIFUGAL PUMP (VCP)

The cooling system pump (VCP) is a ITT Richter magnetic drive pump model ICM 80-50-200. The pump motor is IEC-type 160L, B35, 18.5 kW. The flow rate of the pump is 35 m3/h at 5 bar pressure. See DAI/1816577 and the user manual in Annex B.

5.1.23 VACUUM PUMP (VP)

The vacuum pump VP is KNF model NPK100. See DAI/1985878 and the user manual in Annex B.

5.1.24 LIQUID LEVEL TRANMITTER (WLT)

The liquid level transmitter is Kobolt instruments model AEV2-VK-L1400-SV-TPS343A. See DAI/2351606 and the user manual in Annex B.

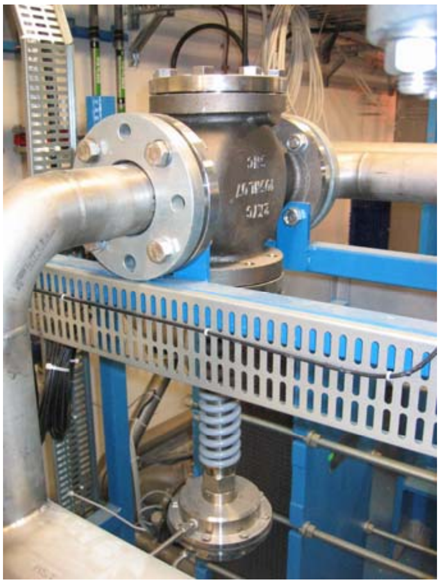
5.2 PHOTO GALLERY

Cooling Station

Cooling system storage tank

Cooling Station – Heat exchanger

Cooling station pump



Differential pressure regulator

Flow meter

Pneumatic 3 ways control valve

Temperature transmitter

Chilled water valves

Pneumatic ball valve

Heat exchanger

Cooling station

Distribution manifold

6. REGULATION PARAMETERS

Parameters signalled with * require access to the PLC source code file and therefore can only be modified by TS/CV-DC.

6.1 REGULATION OF PRESSURE IN RESERVOIR:

Type: ON/OFF

Set-point=0.6 bar(a)

Regulation band = ±50mbar*

Maximum pumping time = 20min*

6.2 REGULATION OF TEMPERATURE

Type: PID

Set point=18 ºC at the range of 16~22ºC

Precision of ±1 ºC

P=see source PL7 code

I= see source PL7 code

D= see source PL7 code

6.3 REGULATION OF SECONDARY CIRCUIT WATER PRESSURE (STATION)

Type: Mechanic (see Annex B / 6.13 DPR)

Set point=1.2~5.0 bar

6.4 REGULATION OF WATER CONDUCTIVITY

Type: ON/OFF

High Set point = 0.7 µS/cm

Low Set point = 0.3 µS/cm

6.5 REGULATION OF SECONDARY CIRCUIT WATER PRESSURE (24 LOOPS)

Type: PID

Set point= 900 mbar.a (modifiable by user)

P= see source PL7 code

I= see source PL7 code

D= see source PL7 code

7. TEST

7.1 HYDRAULIC PERFORMANCE

The hydraulic performance test has not been done.

7.2 COOLING PERFORMANCE

The cooling performance test has not been done.

7.3 LEAKTIGHTNESS TEST

The leak tightness test has been performed to the cooling station, pipeworks between the station and the manifolds, and the manifolds itself. Please see Annex D.

7.4 PRESSURE TEST

The pressure test has been performed to the cooling station, pipeworks between the station and the manifolds, and the manifolds itself. Please see Annex D.

8. PREVENTIVE MAINTENANCE

This chapter has to describe, where applicable, the maintenance procedures to be foreseen to operate the installation. Ex.: report the maintenance procedures and maintenance schedule for a compressor taking the information from the compressor's constructor manual.

Not standard maintenance and operation procedures have to be defined in detail (ex.: chemical analysis of fluid specimens after an amount of run to test fluid qualities degradations).

Information to be retrieved from Mr.Houd, Mr.Pimenta dos Santos and Mr.Bonneau.

9. CONTACT PERSONS

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